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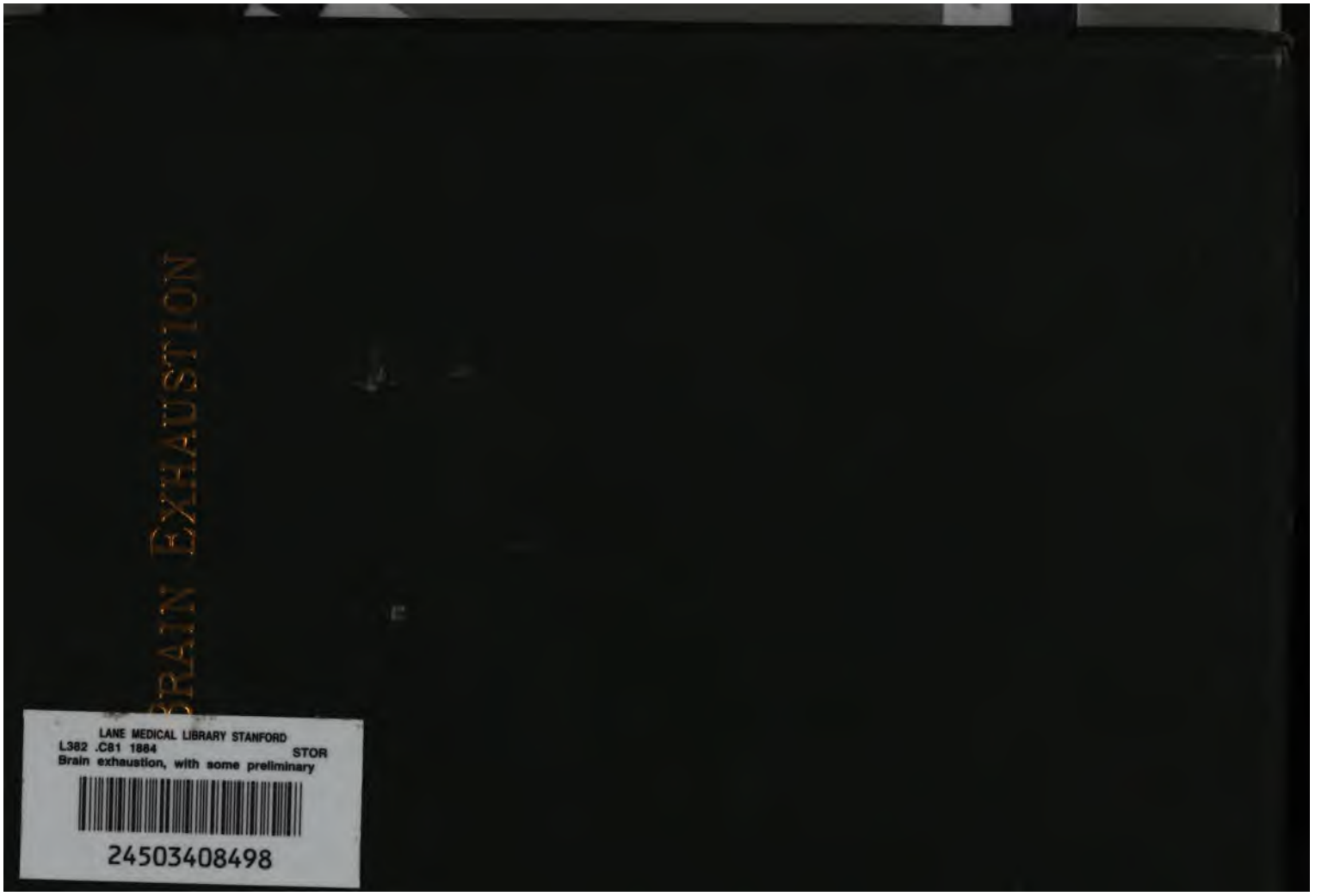
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WITH

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ON

CEREBRAL DYNAMICS.

With the Compliments of the Publishers.

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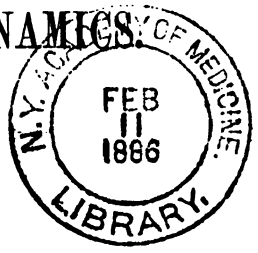
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SOME PRELIMINARY CONSIDERATIONS

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CEREBRAL DYNAMICS.

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BY

J. LEONARD CORNING, M. D.,

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FOR HIS BRILLIANT SCIENTIFIC AND
LITERARY ACHIEVEMENTS.

PREFACE.

An incredible amount of labor has already been bestowed upon the fundamental and minute questions of muscular dynamics.

Interesting as these investigations undoubtedly are in themselves, there is, nevertheless, another field of physiological research, which, according to my way of thinking, transcends all others in importance—I mean the economical questions involved in normal and morbid intellection.

The demands upon the thinking apparatus have never been greater than at present; but, at the same time, the factors which exert a prejudicial influence upon the cerebral mechanism have never been more numerous.

That these are indeed facts, and not assertions derived from mere empty hypothesis, is abundantly proven by the alarming increase of intellectual disorders in this country during the last few years.

In the following pages I have sought to consider, from as scientific a standpoint as possible, a group of symptoms the importance of which is sufficiently evident.

The opinions expressed have been formed from direct clinical observation, and from inferences derived from physiology and experimental pathology.

26 West 47th Street.

New York, *January 1, 1884.*

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INTRODUCTORY AND RETROSPECTIVE.

THE first distinct account of a case of cerebral exhaustion with which I am acquainted is contained in an article entitled "Mental Labor: its Effects on the Blood," by Theophilus Thompson, M. D., read before the Medical Society of London, in 1856.* After speaking of the unfavorable effect upon the mind induced by excessive competition, the author says: "Intellectual, like muscular action, probably involves an expenditure of living material, and introduces a changing series of particles—those which have been used giving place to others, which come with the energy of new life to perpetuate the action." "There may be decay from stagnation—there may be waste from persistency, undue haste, or intensity, especially in creative efforts." "It is only when the function is performed in a calm and equable manner that the equilibrium of expenditure and supply is maintained, and that power is preserved and increased."† These ideas, though not couched in tech-

* The "Journal of Psychological Medicine." London, 1857.

† N. B.—Dr. Ray, in a lecture on the "Physical Health of the Brain," published in 1851, has referred to the prejudicial effects exercised upon the brain by excesses of various kinds. His recital of the symptomatology in

nical terminology, are certainly the outgrowth of a very high order of physiological perceptiveness, and one which, if followed to its proper sequence, would certainly conduce to rational therapy and hygiene.

Upon these preliminary remarks follows the recital of a case which is evidently a very fair illustration of cerebral exhaustion. It is true that the symptomatology is anything but perfect; but enough is stated to establish, beyond reasonable doubt, the identity of the disorder.

With respect to remedies, the author considers those most salutary "which tend to enrich the blood."

Again he says: "As respects the application of medical theories, a wider range of thought should be pursued." "The modifications of many prevalent diseases may have reference as much to mental states as to hygienic conditions of atmosphere and diet." "Every remediable infirmity is a violation of the law of progress. If medicine is to render to the community a full amount of good, it must be not simply in treating the maladies of individual patients, but in ministering to the conditions which disturb the vitality of the race, and thus, while improving our appliances for daily work, remembering that we are enlisted in the service of mankind, we may make posterity our debtors." On the whole, this is a very able paper, considering the slight attention

these cases is, however, so imperfect that it is impossible to form a just estimate of the nature of the disorder which it is intended to describe.

The above observations apply with equal force to an article on "Overworked Brain, and the Nature of the Phosphatic Deposits in the Urine in such Cases," by Dr. E. A. Parkes. "Medical Circular," February 23, 1859.

which had been bestowed upon functional nervous disorders thirty years ago.

The ideas expressed relative to specific deterioration of blood consequent upon excessive mental work appear, however, rather metaphysical, but afford, nevertheless, conclusive evidence of the scientific mind of the author.

Da Costa, in the fifth and earlier editions of his work on "Diagnosis," draws attention to an "affection of the brain which may be confounded with softening: *an exhaustion of brain-power*, encountered among professional men or those engaged in laborious literary undertakings." "What the precise disturbance of the brain consists in is uncertain; it is possible that the nutrition of the organ has been interfered with from over-use and worry, and that the further continuance of mental toil and anxiety would have led to softening." "The phenomena differ from those of this serious cerebral disease by the absence of, or at least by the far less, permanent and marked headache, by the comparatively unimpaired intelligence, and by the non-occurrence of spasms, or of paralysis of motion or of sensation."*

I can not indorse the statement of this able writer to the effect that spasms do not occur in cerebral exhaustion. They certainly do occur, though rarely, especially where the accompanying circulatory anomalies are at all considerable. Where spasms occur, they are usually limited in character, confining themselves to the small muscles of the hand, face, and fore-arm.

* "Medical Diagnosis," by J. M. Da Costa, M. D. Fifth edition. Philadelphia: J. B. Lippincott & Co., 1881, p. 178; also edition of 1864.

Under the designation "Nervous Asthenia," Flint described some of the symptoms of cerebral exhaustion in his work on the "Practice of Medicine," the first edition of which appeared in 1866.*

His exposition of the subject is, however, extremely limited in scope, both as regards the clinical manifestations and pathology of the disorder. Moreover, this author is mistaken in supposing that he was the first observer to consider the morbid condition in question as a "distinct functional affection." Expositions of the symptomatology of the disorder, quite as lucid as his own, had been given prior to 1866.

Forbes Winslow, in his well-known work † published in 1860, gives some very graphic cases illustrative of mental exhaustion. He speaks of the memory in some of these cases as "*being nearly paralyzed*"—a characterization the appropriateness of which will sufficiently appear to those who are familiar with this class of disorders.

Anstie ‡ speaks of the evils of excessive brain-work, and of the detrimental influence exerted upon the nervous system by an undue exercise of the emotions.

A case of "cerebral exhaustion" was reported by

"*A Treatise on the Principles and Practice of Medicine," by Austin Flint, M. D. Fifth edition. Philadelphia: Henry C. Lea's Son & Co., 1881, p. 778.

† "On Obscure Diseases of the Brain," by Forbes Winslow, M. D. London, 1860.

‡ "Neuralgia, and the Diseases that resemble it," by Francis E. Anstie, M. D. New York, 1872.

Dr. George M. Schweig * in 1876. The symptomatology is, however, so defective that it is difficult to satisfy the mind as to the correctness of the diagnosis. The pathological opinions entertained by the author appear, however, to be judiciously formed.

A case of cerebral exhaustion reported by Dr. David Mack † in 1874 is more complete as regards symptomatology than the case of Dr. Schweig.

In 1869 the late Dr. George M. Beard published his original paper on "Neurasthenia." ‡

Some years after the publication of the above article a second communication appeared from the pen of the same author, in which the points of difference existing between "neurasthenia," hysteria, and anæmia were clearly set forth.# The difference existing between the clinical manifestations of spinal "neurasthenia" and those of cerebral origin were previously set forth in an article published in 1874.‖

The symptomatology of both forms of the disorder were described in a more detailed manner in an article which he published in 1878.^A

In 1880 the views previously expressed in the above papers, as well as in numerous other communications,

* "Cerebral Exhaustion," by George M. Schweig. "Medical Record," October, 1876.

† "A Case of Cerebral Exhaustion," by David Mack, M. D. Boston "Medical and Surgical Journal," February 12, 1874.

‡ Boston "Medical and Surgical Journal," April 28, 1869.

"The New York Medical Journal," March, 1879.

‖ "Journal of Nervous and Mental Diseases," 1874.

^A "Virginia Medical Monthly," June, 1878. Also "Journal of Nervous and Mental Diseases," April, 1879.

were modified and considerably amplified in the form of a monograph.*

When Dr. Beard first began to communicate his views upon functional nervous disorders to the profession, his opinions were received with a neglect bordering upon incredulity.

This skepticism is traceable to a variety of causes. First of all, owing to the obscure nature of the pathological processes which give rise to this class of disorders, modern morphological research has as yet done little to increase our positive knowledge respecting the minute protoplasmatic changes which doubtless lie at the root of this and many other forms of functional derangement of the higher centers.

But although inductive research has as yet done little to advance our knowledge respecting the intimate nature of these occult morphological changes, and will, in all probability, accomplish but an insignificant amount in this direction in the near future, there still remains the possibility of establishing very satisfactory conceptions concerning the sources of these groups of morbid symptoms by calling physiology to our aid. In other words, we are reduced to the necessity of formulating a system of inferential pathology which, though far from affording the realization of ideal scientific exactness, is nevertheless vastly preferable to that utopian and transcendental pathology which has been put forth by various medical visionaries in connection with functional nervous disorders. It was Dr. Beard's misfortune, like that of

* "Neurasthenia," by George M. Beard. New York, 1880.

most other men of copious understanding, to have said, and also to have recorded, some things which had, perhaps, better have remained unsaid and unwritten. Regarded, however, from the standpoint of a broad and liberal interpretation, his writings assume commanding proportions; they are indeed what may be regarded, to all practical intents and purposes, as the pioneer efforts of a far-seeing mind in the hitherto unexplored regions of one of the most important domains of neurology. True, *some* of the phenomena had already been observed by others; but the fact still remains that, previous to the advent of his writings, a most important domain of neurology was practically closed to exploration. He showed the way; and I venture to predict that many will follow in the path which his perspicuity served to illuminate. The field is broad; there is no lack of room for scientific workers. The contributions to the department of neurology, which occupies itself with the consideration of functional phenomena, has exhibited a well-marked progressive tendency since the publication of Dr. Beard's earlier papers. This is particularly true of the very extensive literature upon these subjects which has appeared in Germany of late years.

Among the most comprehensive papers which have appeared upon the subject of cerebral exhaustion since Dr. Beard's earlier publications is Dr. Radcliffe's admirable article published in 1873.* It is matter for surprise, however, that this author should have presented so

* Article in London "Lancet" of April 12, 1873, by C. B. Radcliffe, M. D.

extensive a survey of the subject; should apparently have profited by the writings of Dr. Beard, and yet have made no kind of reference to the same. Indeed, he appears to imagine himself the first in the field. Such slight omissions require correction, as they are liable, when passed by unchallenged, to lead to misapprehension.

Weir Mitchell's * little book on "Wear and Tear" is among the more recent contributions to the literature concerning the effects of over-work and worry upon the mind. The subject is, however, treated in an extremely popular manner, little heed being paid to the intricate questions of physiology and pathology involved.

Dr. Hammond's † admirable little work on "Cerebral Hyperæmia" contains many facts of interest in connection with the subject of mental strain. The novelty of the work consists more particularly in the nature of the pathological conclusions at which the distinguished author arrives. Thus pre-eminent importance is assigned to vascular changes, particularly to the condition of cerebral hyperæmia.

Though, according to my own way of thinking, these phenomena, when they exist, are, pathologically speaking, secondary to primary exhaustion of the cerebral cell, they are by no means of subsidiary importance from a therapeutic point of view, as, when once established,

* "Wear and Tear." Philadelphia: J. B. Lippincott & Co. The date of publication is not indicated on title-page.

† *Vide* also chapter on "Cerebral Congestion," contained in Dr. Hammond's work on "Diseases of the Nervous System." New York: D. Appleton & Co., 1881.

they in their turn react in a most prejudicial manner upon the already affected ganglia.

I can not help believing, therefore, that, in drawing attention to the importance of these vascular phenomena, Dr. Hammond has rendered substantial aid to the subject of morbid cerebral economies.

Dr. J. Crichton Brown belongs in the category of those English writers who in recent times have done much toward systematizing the study of functional nervous disorders.

My own principal contributions in this direction are: An article published in the "Medical Record," February 18, 1882; a monograph published by Anson D. F. Randolph & Co., New York, March 29, 1882; a paper read before the New York Neurological Society, June 6, 1882, and subsequently published in the "Philadelphia News" of June 17, 1882; an article published in the "Medical Record," April 7, 1883; a monograph on "Brain-Rest," published by G. P. Putnam's Sons, New York, March 15, 1883; a paper "On the Nature of Nervousness," contained in the "Medical Gazette" of November 24, 1883; a paper read before the Medical Society of the County of New York, and published in the "New York Medical Journal" of December 29, 1883, and the present publication on "Brain Exhaustion."

PRELIMINARY CONSIDERATIONS.

I.

THE RELATION OF THE LAW OF THE CONVERTIBILITY OF FORCES TO THE DYNAMICS OF THE HEALTHY AND MORBID BRAIN.

SINCE the time when physiology first took rank among the sciences there has been an endeavor on the part of investigators, in this most important branch of research, to identify the forces manifesting themselves in the living organism with those acting in the domain of the inorganic world. But, while many of the phenomena of the living organism may be explained on the basis of what is known of the operations of external forces, there remains yet another group of manifestations which appear to differ in some important respects from the usual phenomena of chemistry and physics. These manifestations have received from some writers the specific designation of *vital* forces, of which subject more hereafter. One of the most important and far-reaching principles of physics is the comparatively recent doctrine of the "Convertibility of Forces." The essential features of this broad generalization were first clearly enunciated by Mayer, a physician of Heilbronn, Germany, though Newton doubtless predicted the eventual establishment of the doctrine.

Regarded from Dr. Mayer's point of view, "forces are causes, in which full application of the axiom must be found that every cause must produce an effect which corresponds and is equal to the cause. '*Causa aequat effectum.*' Thus, if a cause, C, produces an effect, E, then C = E. Should the effect E become the cause of another effect, e, then also E = e = C. In such a chain of causes and effects, no link or part of a link can ever become nothing = nothing. Should a given cause, C, have produced its corresponding effect, E, then C ceases to exist, for it has been converted into E. Consequently, as C passes into E, and the latter into e, it follows that all these causes, as far as relates to their *quantity*, possess the property of *indestructibility*, and to their *quality* that of *convertibility*." * It is with this characteristic of convertibility that we shall be chiefly concerned in the following considerations, which, however, possess no claim to exhaustiveness. The object, indeed, of the present discussion is purely suggestive, it being essential, according to my way of thinking, in the present state of knowledge, to make all forms of intellection correspond, as far as possible, with the highest forms of scientific generalization. By this I do not wish to arouse the anticipation of any especially novel views with regard to brain-function as such. What most concerns me here is the refutation of that absurd doctrine which insists upon regarding mind as something without the pale of natural law—as a thing *sui generis* in its

* "The Connection and Equivalence of Forces," by Justus von Liebig, contained in his "Familiar Letters on Chemistry."

relation to other vital phenomena. No doubt the majority of biologists, and sociologists as well, have long since come to regard brain-force from a standpoint in harmony with the teachings of evolution. There are many persons, however, who still look with suspicion upon the physiological method of regarding mind; and for no other reason, apparently, than because of a morbid fear that such a manner of contemplating intellectual phenomena might result in abrogation of the doctrine of the immortality of the soul. Nothing more illogical, however, can be imagined than such a deduction. We are bound, indeed, to study the laws under which mind manifests itself in living organisms; but what has such investigation to do with the eventual destiny of the phenomena themselves when they escape beyond range of scientific inquest?

The law of the indestructibility of force is rather an argument in favor of the perpetuation of mental phenomena in some form than otherwise.

But to return to the specific subject of discussion.

This law of the convertibility and indestructibility of causes, this doctrine of the "conservation of forces," has received such substantial support from the researches of Joule, Grove, Farady, Tyndall, and Thomson, that it may now be ranked among the most thoroughly established generalizations of physics.

This is, however, not the place to enter upon the discussion of the application of the doctrine of the correlation of forces to the phenomena of the inorganic world. It is eminently proper, however, in the face of

the great gain accruing to scientific investigation in the inanimate world by the application of this law, that an earnest effort should be made to apply the principles of its teachings not only to the contemplation of vital phenomena as a whole, not only to the general dynamics of the organism at large, but also to the economics of the individual organ.

First, then, as to the relation of the law of the convertibility of forces to the phenomena of vegetable and animal life in general.

When carbonic acid, water, and zinc are brought together they exercise a certain effect upon each other. By reason of chemical affinity, a powdery compound is formed, which contains carbonic acid, zinc, and oxygen from the water. At the same time hydrogen is evolved.

In plants, the bud, or part of the plant, takes the place of the zinc. The growth of the plant results in the formation, from carbonic acid and water, of chemical compounds containing carbon and hydrogen, or carbon and elements of water, and *oxygen* is at the same time evolved.*

Sunlight acts upon the plant very much in the same manner as electricity, which neutralizes the attraction of the elements of water, thus separating them from each other. The light of the sun is therefore absolutely necessary to the growth of the plant. Moreover, heat is indispensably requisite to the evolution of the phenomena of plant-life. Not only, however, does the plant owe its development to heat, but the *germ*, that supposed

* *Op. cit.*

repository of an independent "*vital principle*," "*bildungstrieb*," or "*germ-force*," is absolutely incapable of any specifically constructive act of its own, without the active assistance of heat. Thus, if the seed be excluded from a free access of air, if moisture be denied it, and if the temperature be maintained sufficiently low, it may be kept in a condition of perfect inaction for any length of time. When, however, the three requisites of air, moisture, and heat are again brought to bear upon it, germination takes place. It is therefore perfectly evident that heat can not be regarded simply in the light of "*a vital stimulant*" to the germ, as some would have us believe, but that it must rather be looked upon as the active constructive force. Otherwise, if heat were merely a primary "*stimulus*," the seed having germinated and the plant having started on its career of development, there should be no further use for this caloric "stimulus." As we have seen, however, heat is a developmental *sine qua non* throughout the entire career of the plant. Viewed in the light of the foregoing exposition, Carpenter's* proposition, to regard the functions of the germ in the light of a "*directive agency*," is particularly appropriate.

As Carpenter† rightly observes, however, "the condition of the plant which has attained a more advanced stage of development differs from that of the germinating embryo essentially in this particular, that the organic compounds which it requires as the material for the ex-

* "On the Correlation of the Physical and Vital Forces." A paper, by William Benjamin Carpenter, 1850.

† *Op. cit.*

tension of the fabric are formed by itself, instead of being supplied to it from without." "The tissues of the colored surfaces of the leaves and stems, when acted on by light, have the peculiar power of generating—at the expense of carbonic acid, water, and ammonia—various ternary and quaternary organic compounds, such as chlorophyll, starch, oil, and albumen; and of the compounds thus generated, some are appropriated by the constructive force of the plant (derived from the heat with which it is supplied) to the formation of new tissues, while others are stored up in the cavities of those tissues, where they ultimately serve either for the evolution of parts subsequently developed, *or for the nutrition of animals* which employ them as food."

From these facts Carpenter draws the inference that "the influence of light upon the vegetable organism appears to be essentially exerted in bringing about what may be considered a higher mode of chemical combination between oxygen, hydrogen, and carbon, with the addition of nitrogen in certain cases; *and there is no evidence that it extends beyond this.*" "That the appropriation of the materials thus prepared and their conversion into organized tissue in the operation of growth and development are dependent on the agency of *heat*, is just as evident in the stage of maturity as in that of germination."

Through the agency of the continual decay incident to plant-life, a portion of the products drawn from the inorganic world is restored to it in the form of water, ammonia, and carbonic acid. Another portion of vege-

table products is consumed by men and animals as food, while yet another part is reserved as fuel (wood, etc.).

The eventual entire decay of the plant completes the process of restoration. We have here a most beautiful illustration of the indestructibility of matter and force.

But what is their characteristic in the sources of that vital force which lends animation to the organism of the higher animals?

The first fact of importance in this connection is the evolution of the germ in the mammalia by the *heat* to which the ovum is exposed within the body of the animal.

During the period of early infancy the child is supplied with an adequate amount of nourishment by the act of lactation.

Later on it becomes dependent upon food derived from the external world for its maintenance. This food is derived either directly from the vegetable kingdom, or from animals which have obtained their nutriment from plants. In any case the dependence of the vital phenomena exhibited by animals upon plants is sufficiently clear. It is therefore evident that all vital manifestations are *ultimately* dependent upon heat derived from the sun. Some have gone even farther, and sought to determine the source of solar heat itself.

The great difference between the vegetable and animal kingdoms consists in the diversity of their respective relations to the inorganic world.

Thus the vegetable is continually occupied in "raising" its structural materials from a lower to a higher chemical grade by means of the force derived through

the instrumentality of the solar rays. The animal, on the contrary, elevates one portion of these constituents (of the plant) to a still higher grade by the disintegration of another portion, through the process of oxidation.

The maintenance of the collective vital functions of living men is dependent upon the co-existence of two phenomena. The first of these is the disintegration of the tissue itself by oxidation, and the second is the repair of the waste consequent thereupon. The forces liberated by these processes are ultimately traceable to *food.*

Now, when we come to examine as to the special conditions which are necessary to the *maintenance of the specific functions of an individual organ,* we find, in the first place, an elaborate distributive apparatus—the circulation—consisting of canals, containing a fluid the heterogeneous composition of which, *under normal circumstances,* corresponds to the nutritive requirements of every tissue in the body. The blood-stream may, in fact, be regarded as the principal repository of all those elements which, having been primarily organized in the plant, were subsequently modified in the organism itself in such wise as to meet the vital exigencies of every tissue. But, in addition to transporting the pabulum of the organism, the blood-stream also receives oxygen from the external atmosphere through the intermediation of the pulmonary air-cells, and conveys the same to every tissue. It is thus that the perpetual calorification necessary to the life of the individual is maintained. Under normal circumstances the oxygenation of the tissues is neutralized by

commensurate nutrition. Sometimes, however, under certain morbid conditions, to be presently referred to, this is not the case, and a predominance of tissue-waste over repair is the inevitable result. This waste may manifest itself in a devitalized condition of the whole organism, or in that of a single organ, according to whether the morbid demands upon vital resources have been general or circumscribed. The wide significance of these economic considerations will appear in the course of the discussion.

From the repository of vital energy represented by the blood-stream, each organ, with an elective faculty peculiar to itself, selects only such elemental combinations as are required for the evolution of those vital forces peculiar to itself. Now, imperfect as is still our knowledge of tissue metamorphosis, we have yet accumulated evidence sufficient to show that the qualitative and quantitative nutritive exigencies of the various organs differ widely. As long, however, as the output of vital force, from any single organ or group of organs, does not differ too greatly in amount from that required from the remaining tissues of the body, all will be found to go well, as the diversity of the nutritive facilities of the blood will be found to equal all ordinary demands.

When, however, one particular organ exercises its functions to an inordinate degree, two phenomena are witnessed. In the first place, the elements of the blood required for the maintenance of the specific functions of the particular organ in question are more or less completely exhausted. Secondly, when this state of things

has become established, the inordinately active organ proceeds to borrow nutriment from those other organs which contain the elements required for the maintenance of its own specific functions.

One of the most striking instances of this plundering of one organ by another is exemplified by certain inordinate brain-workers. It happens not infrequently in the case of such persons that the fatty, and particularly the muscular, tissues are reduced to a surprising degree—so much so, in fact, that these individuals often exhibit a considerable amount of emaciation. This is particularly true of those whose digestive facilities are deficient or deranged. Such persons as these are extremely prone to become the victims of brain exhaustion, or some other form of functional cerebral derangement. Nor is this to be wondered at when the striking exhibition of physiological impairment which these persons afford is duly considered. I have remarked that these individuals are inordinately susceptible to even trivial sources of mental irritation. Thus, worry, and, indeed, all forms of emotion are liable to become the source of functional, or even permanent brain trouble in such cases.

Having thus traced the progressive conversion of forces from the store-house of the vegetable world to the organ of the living animal, it now remains to consider briefly some of the conditions which are necessary to the normal evolution of vital forces within the cell. Unfortunately, the subject of cell nutrition is as yet involved in considerable obscurity. Nevertheless, there are certain phenomena which, when properly interpreted, will enable

us to establish inferentially some principles with regard to the matter which may prove of practical utility, particularly in dealing with cases of functional brain trouble. One of the most important facts in this connection is the occurrence of cerebral exhaustion in cases where there is no discoverable decrepitude of the apparatus of assimilation on the one hand, nor any appreciable blood impoverishment on the other. The exciting causes in such cases will usually be found to be excessive worry or excessive work, or, more frequently still, the two factors combined.

We have here presented the spectacle of an abundant supply of nutriment to the organ, and yet inability on the part of the cell to appropriate it. There is but one inference to be drawn from such facts, namely, that the brain-cell, like the organism at large, is only capable of exercising a certain amount of absorbent force. Now, let the capacity of restoring waste possessed by the cell be overtaxed; let its power of individual recuperation be annulled by excessive function; let cell-waste prevail over cell-repair, and we have a state of things which leads as certainly to cerebral bankruptcy as does impairment of the digestive faculties to that of the whole organism.

Thus, from the interpretation of pathological phenomena, do we arrive, not only at certain just conclusions respecting the dynamics of the cell, but also at a proper estimate of the limitations of therapeutics in cases of impaired brain energy.

It will be found in the course of the subsequent discussion that some of the points referred to in this place

will be alluded to hereafter. This repetition is, however, necessary, in order to exhibit the facts involved from different points of view.

Where the pathology of a subject, eluding the ordinary methods of morphological research, is capable of elucidation only by the aid of deduction, it is impossible always to consider the physiology and pathology of the subject under separate headings. I have therefore allowed myself to be cramped by no mere arbitrary subdivision of subjects.

There is one general fact which the foregoing considerations have served to exemplify, and that is the paramount importance of heat to the metamorphosis of both the vegetable and animal economy. Indeed, we seem justified in asserting that the correlation between heat and the organizing forces of the plant, the animal, the organ, and the cell, is not less proximate than that existing between heat and motion.

The truth of this will appear still more evident when a more specific examination is made into the question of cerebral function.

II.

FURTHER CONSIDERATIONS ON CEREBRAL METAMORPHOSIS.

HAVING in the previous paragraphs discussed some of the fundamental principles of vital motion, more especially as applied to the dynamical exigencies of cerebration, it now becomes necessary to bestow some attention upon the prominent features of brain metamorphosis as far as they are at present understood.

Before proceeding to the consideration of the laws, the observance of which is necessary to the preservation of the physiological integrity of the mental mechanism, it is necessary to form some conception of those principles which lie at the root of healthy mental phenomena. By this I do not wish to arouse the anticipation that the whole field of cerebral anatomy and physiology is to be reviewed. On the contrary, what is aimed at is to set forth, in the light of their true importance, certain principles of cerebral action, the proper comprehension of which is essential to any well-considered plan of brain hygiene.

Not only, however, is some specific knowledge of the principles of cerebral physiology necessary to an enlightened mental hygiene, but even the limited demands

of a yet imperfect cerebral pathology exact, as a preliminary condition, some sort of an estimate of normal brain action. The above applies with particular force to functional brain troubles, in the investigation of which the usual resources of the pathologist can be of but slight avail. I do not offer these observations with any desire to disparage what has already been accomplished in the pathology of organic diseases of the brain and spinal cord. What I do mean to say, however, is this: that, in estimating the significance of functional cerebral troubles, physiology will prove our most valuable guide, in the present state of knowledge at least, whatever the future is destined to bring forth.

Previous to the time when the mechanism of intellection was regarded as a legitimate field for scientific exploration, the most diverse and fantastic theories prevailed respecting the evolution of mental phenomena. Thanks, however, to the researches of the last twenty years, our conceptions concerning cerebral physiology have been very considerably extended. There are various reasons why delay should have occurred in this branch of research, the most prominent of which, as previously noted, is undoubtedly found in the wide-spread habit of regarding mental phenomena as something *sui generis*—as a manifestation of forces beyond the ken of even the most advanced science. As a result of all this, a belief is widely prevalent to the effect that the mind is in a measure independent of the laws which prevail in the more profane domain of bodily action. This habit of divorcing the mind from the body has been one of the most prolific

sources of evil; not because all forms of bodily decrepitude necessarily end in mental failure, but because non-recognition of the physiological principles underlying mind has led to the most wholesale abuse of the mind mechanism. Of the metaphysics of mind, then, little will be said in the following pages. I shall rather confine myself strictly to certain cardinal physiological principles, leaving the unascertainable in the hands of the speculative psychologist.

There are three factors of primary importance to brain-action, viz.:

1. The condition of the nerve-cell.
2. The condition of the cerebral blood-stream.
3. The physiological relationship of the first two.

In order that a nerve-cell concerned in the evolution of mental force shall properly perform its function, it is necessary that the intra-cellular nutritive conditions shall be both qualitatively and quantitatively physiological. There should be such a supply of explosive material within the cell as to exclude the possibility of a premature exhaustion of cell-energy. Again, the protoplasm of the cell itself should be of such kind as to undergo the metamorphosis incident to function with sufficient readiness to preclude lethargy, but not so rapidly as to give rise to needless expenditure, as is, for example, the case in acute mania and certain forms of excessive irritability. Although the present means of investigation do not admit of our penetrating very profoundly into the mystery of the physics and chemistry of the cell, there is no doubt that, if this chapter could be adequately written,

it would form one of the most transcendent acquisitions of exact science. Nevertheless, in spite of the fact that there are phenomena of cell-life which baffle our present means of investigation, we are still in a position to indicate approximately, at least, some of the more important conditions to the existence of the nerve-cell.

The Nutritive and Functional Office of the Blood-Stream.—After the nerve-cell has exercised its functions for a certain length of time, the energy of its action gradually diminishes until there is more or less complete suspension of activity. At all events, the above holds true of those cells concerned in the evolution of psychical and motor phenomena. Those groups of cells, however, which constitute the "vital centers" (*nœud vital*), *appear* to be constantly active. I say *appear* to be constantly active; for, when we come to examine more closely into the nature of this activity, we find that we have in reality to do with rhythmically interrupted functional periods. During the rhythmical pauses in respiratory and cardiac activity there is a corresponding cessation of activity on the part of the centers which control those functions. These periodic pauses are virtually what sleep is to the higher centers; without them a permanent condition of cell-exhaustion would soon become established. This obvious repose of the "vital centers," which is in perfect accord with all which we know respecting the periodicity of cell-function, has, apparently, been overlooked by some physiologists; but without some such arrangement, as we have seen, the vital resources of the cell would soon become extinguished.

To return again to the specific consideration of mental phenomena, we find that only after the waste incurred by the psychical mechanism during the day has been neutralized by repair, which takes place during sleep, is the nerve-cell again prepared to resume its wonted activities. Now, if the blood-stream were capable of effectually neutralizing the waste of the cell *during* the functional activity of the latter, we should have nervous expenditure with concomitant reimbursement, and there would remain not the slightest necessity for sleep. As it is, however, waste outstrips the resources of supply; and it is only when all mental function and consciousness itself has been temporarily suspended that the blood-stream is able to again supply the protoplasmatic deficit of the previously active nerve-cell.

It is evident, therefore, that during activity, disintegration outstrips the resources of repair, whereas during sleep the amount of integration far exceeds any slight waste which may result from a minimum of activity on the part of the cell (as in dreaming, unconscious cerebration, etc.). But what is the condition of the blood-stream during the activity as well as during quiescence of the cell?

Experimental research has shown that during mental activity the amount of blood circulating in the brain is increased, and that with this increase there is a rise in temperature over the cerebral hemispheres.* Now, is

* *Vide* "Sleep and its Derangements," by William A. Hammond, M. D. Philadelphia: J. B. Lippincott & Co., 1869. Also, "The Physiology of Sleep," by Arthur L. Durham. "Guy's Hospital Reports."

this afflux of blood and rise in temperature a mere accidental concomitant, or is it a physiological factor of consequence to the maintenance of cerebral function? In a series of experiments undertaken over two years ago, I sought to elucidate this matter;* and, for the sake of the completeness of the argument, I append the results then obtained, although they have already been published elsewhere.

EXPERIMENT I.—I compressed both carotids of a man of full habit with an instrument devised by me for the purpose, and observed, as pressure was rapidly augumented—

a. Facial pallor.

b. Drooping of the eyelid.

c. Dilatation of the pupil.

d. Soporific tendency.

e. Dizziness.

f. "*Heaviness*" *and confusion of ideas.* (The subject complains that he is unable to "collect" his thoughts, and is unable to think.)

g. Syncope (produced by excessive pressure).

Besides the above experiment, which was undertaken with great care and frequently repeated, I also had occasion to investigate the effects produced by anæmia of the brain upon muscular contraction. As those experiments have, however, little to do with the present argument, I abstain from quoting them on the present occasion. Enough that the above experiments incontestably

* *Vide* a paper read by me before the New York Neurological Society, June 6, 1882, and published in the "Philadelphia News" of June 17, 1882.

prove the paramount necessity of the blood-stream to brain-function; only in so far as the ganglia are supplied with arterial blood do they live and exercise their function. To such a degree does the above hold true that even a momentary suspension of the circulation in the encephalon is sufficient to cause arrest of the entire vital mechanism. Furthermore, if the head of a decapitated animal be injected with defibrinated and oxygenated blood, the indications of life frequently return in the most wonderful manner. Thus Dr. Brown-Séquard has resorted to this expedient in the case of dogs, in order to exhibit the exceptionally intimate relation existing between arterial blood and cerebral function.* Decapitation having been performed, defibrinated blood was injected into the vessels of the brain; and, signs of life returning, the animal was called by name, when, wonderful to relate, the eyes of the head turned in the direction of the experimenter.

It was reserved, however, for the physiologist, Schiff, to *directly* investigate the temperature of the brain when under the influence of external excitations.† He employed for this purpose very delicately constructed thermoscopic instruments, by means of which extremely accurate results were obtained. In speaking of the evolution of heat during the processes of intellection, Schiff says: "The psychical activity, independently of the sensorial impressions which call it into play, is connected with a production of heat in the nervous centers, a

* "Annales médico-physiol.," 1870, p. 350 *et seq.*

† "Archives de Physiologie," 1870.

greater amount of heat than that which simple sensorial impressions engender." Furthermore, Schiff has shown that the local development of heat consequent upon the advent of an impression in the particular district where it disseminates itself is a dynamic phenomenon, *quite distinct from any mere activity on the part of the circulation.* We have, briefly stated, to do with an evolution of heat in the psychical centers which takes place on the advent of the sensorial excitation.

Now, since the phenomena of brain-activity are evoked by the presence of *oxygenated* blood, and since, furthermore, *venous* blood is absolutely fatal to normal intellection (witness the mental condition of an epileptic during the second stage of the attack), we are perfectly justified in assuming that the evolution of mental phenomena is essentially a chemico-vital process, in which oxygenation of the cell-plasma is the great feature. The more intimate nature of nerve-cell chemistry is, to be sure, a *terra incognita*, into the fastnesses of which even the most sanguine physiologist can hardly hope to penetrate. Nevertheless, the wonder is that we know anything of brain physiology whatever, when we consider the extreme inaccessibility of the organ to direct experiment. But, although the more intimate molecular changes of the ganglionic protoplasm are, as we have seen, stil unknown, there is yet one principle of mental chemistry which appears to be well established; I refer to the important place occupied by the phosphates in cerebral physiology. It is to Dr. Hammond that we are indebted for a series of experiments bearing upon this

question in cerebral metamorphosis. * These researches shed considerable light upon the question as to how far the composition of urine is affected by increased and diminished intellectual labor. Although some would have us believe that the results obtained by Dr. Hammond in this direction are open to question, I have yet to see sufficient evidence to detract, in whole or in part, from the scientific exactness of his conclusions. As the experiments here referred to are very suggestive, I can not do better than summarize, in Dr. Hammond's own words, the conclusions at which he arrived after a series of very carefully conducted urinal analyses.

Those conclusions are:

1. That increased mental exertion augments the quantity of urine.

2. That, by its influence, the urea, chlorine, and phosphoric and sulphuric acids are increased in quantity.

3. That the uric acid, on the contrary, is very materially reduced in amount.

4. That diminished intellectual exertion produces effects directly contrary to all the above.

The nature of the method adopted in these experiments will appear more fully in the course of the subsequent discussion.

More recently, Byasson † has demonstrated that the activity of the ganglia is accompanied by an expenditure of phosphorized material, and, furthermore, that this

* "Urological Contributions," by William A. Hammond. "The American Journal of the Medical Sciences" for April, 1856.

† "Journ. d'anat. de Robin," 1869.

gre... ...city is eliminated from the
im... ... in the form of phosphates
that ... this observer found that the
adve... ... sulphates secreted stands in
it dis... ...quantity of mental energy ex-
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tion of he en length of time. In order
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Now, si... ...searches upon himself: He ascer-
evoked by t... ...of sulphates and phosphates
furthermore. ... as well as the amount excreted in
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justified in as... excreted in the urine was again
nomena is ess... being a notable increase of both
oxygenation of... Besides this, it was noted that
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a *terra incognita* ... of mental work.
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...Archives of Medicine"

total of phosphates found in the urine." In this paper I find no mention of the well-known experiments of Dr. Hammond, nor yet of those of Byasson, and can only infer that Dr. Edes is unacquainted with them. But this evident lack of familiarity with the work of previous observers in this direction might be extenuated had Dr. Edes's experiments been undertaken with the requisite amount of preliminary precautions. But this, so far as can be judged by the published report of his paper, is not the case. I can find no trace of a regular dietetic scale, nor yet of any sort of system with respect to physical exercise or sleeping.

In all such investigations as these it is necessary to reduce the food, physical exercise, and mental labor to a perfect system; otherwise we have no sort of protection against sources of error. Nothing is more certain, for example, than that ordinary variations in food and physical exercise would influence the results of such experiments. Now, in Dr. Hammond's experiments careful attention was bestowed upon these points. First, a normal standard of the several constituents of the urine was obtained under exact conditions of nourishment, physical exercise, and mental labor. Then, without varying either the amount of physical exercise or that of the food, the mental labor was doubled. Therefore, any variation in the constituents of the urine can only be attributed to the increased mental labor, since that was the only factor which was in the slightest degree varied. Hence the increase of phosphoric acid and other urinary products can only be regarded as the direct result of the

increased mental labor. But now, suppose that with the increase in the amount of mental labor there had also been modifications of diet and physical exercise, could, therefore, the results of urinal analysis obtained under such circumstances be utilized to prove or disapprove that brain metamorphosis was or was not wholly or in part responsible for those same results? Most assuredly not; and yet this is precisely what Dr. Edes asks us to do. It must thus appear evident, to even the most superficial logician, that Dr. Edes's experiments possess inherent defects, which seriously detract from their value as scientific evidence for or against the opinions now so widely prevalent respecting the important part played by the phosphates in the processes of intellection.

But, as we have seen, not only is there a considerable increase of phosphoric acid incident to intellectual work, but likewise all the other urinary products are increased, except the uric acid. This decrease in the amount of uric acid is, however, perfectly comprehensible, if we accept the theory of Liebeg respecting the origin of urea.

All these facts are in perfect accord with what we know respecting the effect of excessive brain-work upon the general system. Those who are obliged to use their brains very intensely for considerable periods of time often exhibit a very great loss in weight. This is particularly true of those of inconsiderable size—individuals whose stock of reserve resources must of necessity be small. Brain failure is very common among this class of persons. Sometimes they become victims of brain ex-

haustion while attending the school or college; but quite as often the morbid brain fatigue appears as a sequence of some sudden excess, combined, it may be, with worry or great mental labor.

On the other hand, brain exhaustion is not necessarily one of the possible heritages of the weak and physically ill-favored alone, for it is frequently encountered among those of pronounced muscular development. When interrogated, such individuals usually state that their principal occupation has been one demanding an amount of mental labor nothing short of excessive, and that, in order to counteract the ill effects of over-mental work, they have had recourse to violent muscular exercise. Instead, however, of obtaining relief, the stomach, as well as the brain, at last gives way, and the subject is reduced to a deplorable state of incapacity. We have here presented to us the picture of an already overtaxed and inadequately nourished brain, exposed to additional impoverishment by reason of the demands of an abnormally developed muscular system upon an already insufficient blood-supply. In an effort to supply both the nutritive demands of the overworked brain and the abnormally developed muscles, the digestive powers are overtaxed and the miserable picture is complete. These cases have received all kinds of designations. Sometimes they are called hypochondria; again we hear them cited as instances of nervous dyspepsia, or it may be they have been set down to the account of "malaria" or "neurasthenia." Whatever such cases may be called, however, it is of the utmost importance to have definite

ideas respecting the true nature of their ultimate causation, otherwise scientific treatment becomes an impossibility.

Finally, let me say that this slight clinical digression, though apparently out of place in this chapter, has been undertaken as an illustration of the fact that the brain, like other organs, is capable, through an excess of functional activity, of diverting nourishment from other portions of the body, thus giving rise to inadequate development of the latter. And, on the other hand, that, where the digestive facilities are not of the best, an inordinate development of other organs, particularly of the muscles, has a tendency to limit the blood-flow to the brain, and may even be a predisposing factor of cerebral exhaustion. That the amount of nourishment required by the brain, as well as the degree of metamorphosis in the same must be prodigious, is amply proven by the great size of the arteries and veins which lead to and from the encephalon, as well as by the extreme vascularity of the organ itself. Moreover, the great loss of weight resulting from excessive and prolonged use of the mental faculties affords a graphic illustration of the prodigious amount of vital energy which the brain is capable of appropriating. Where the amount of organized material, appropriated by the digestive faculties from the external (plant) world, is insufficient to meet the exorbitant demands of the inordinately active brain, the necessary substance is purloined from other tissues, and emaciation and physical degeneracy are the result.

Inordinate development of the muscles in persons of

limited digestive facilities tends to the nutritive impoverishment of the central nervous system, and, consequently, to a limitation of their specific vital functions. On the other hand, inordinate abuse of the mental faculties tends not only to the production of intellectual decrepitude, but also to nutritive impoverishment and degeneracy of the entire system. Excessive development and use of the muscular system, combined with worry and inordinate intellection, means usually both physical and mental bankruptcy—it is simply burning the candle at both ends.

III.

THE EMOTIONS OF THE HEALTHY AND MORBID MIND.

According to some psychologists, the term emotion is used to include all that is implied by feeling, pleasure, pain, passion, sentiment, affection, hate, etc., etc. Bain, among others, employs the term in this sense.

In order that an emotion shall be produced, McCosh is of the opinion that "there is need first of some understanding or apprehension." * With this opinion Hammond † is inclined to disagree, and very properly, it seems to me, assigning as a reason the well-known fact that a simple perception, even though not attaining to the dignity of an idea, may result in the production of very considerable emotional phenomena. Thus various visceral disorders—such as indigestion, constipation, hepatic and kidney troubles—may give rise to symptoms of profound depression. Hammond goes even a step farther and declares that "emotions may be developed as the direct consequences of disturbances in the viscera, *unaccompanied* by any sensation whatever, as, for instance,

* "A Manual of Psychological Medicine." London, 1858, quoted by Hammond.

† "Treatise on Insanity," etc., by William A. Hammond, M. D., p. 25. D. Appleton & Co., New York, 1883.

the mental depression, with its accompanying emotional disturbances, due to painless liver disorders, and like states developed by morbid conditions of the blood circulating in the brain." *

Very curious is the influence exercised by musical tones of different degrees of combination and pitch in the development of the emotions. Some time since, while fulfilling the functions of physician to an insane hospital, I profited, by the abundant opportunity afforded, to conduct some researches respecting the effect of various musical sounds upon the insane mind. I was greatly assisted in these investigations by the aid afforded me by Dr. Joseph M. Cleaveland, Superintendent of the "Hudson River State Hospital for the Insane"—a gentleman, by the way, whose courtesy is only matched by his efforts in the cause of scientific psychiatry. Without going into details, I will simply state that my observations in this direction have led me to the following conclusions: 1. That the *kind* of instrument has very little to do with specific effects upon the insane mind. The result produced by the violin, flute, piano, organ, or horn, were practically the same. 2. On the other hand, variations in pitch produced the most marked effect upon the emotions of those of unsound mind, the impression produced being, in fact, far more extreme in character than the corresponding result in those of sound intellect. The deep notes of the organ reduced those whose delusions were often of an exalted nature to a condition of the utmost depression, while the sharp,

* *Op. et loc. cit.*

shrill notes of a flute, or the rasping tones of a violin in the upper octaves, were quite sufficient to arouse a whole ward from previous lethargy to the wildest excitement. I remember, in this connection, the conduct of a patient rather advanced in years, and usually of a somewhat morose and silent disposition. On hearing a few accords in the high octaves played upon a violin by an attendant of the hospital, this man sprang from the corner in which he was accustomed to sit during a greater part of the day, ran across the room, and, having gained sufficient momentum, threw himself upon a table, over which he shot very much after the manner of certain French acrobats. The somewhat peculiar manifestation of this old gentleman's exaltation was at once so startling that the inmates of the entire ward were convulsed with the most immoderate laughter.

This excessive susceptibility to emotions, particularly those of depression and anger, is not only characteristic of extreme mental derangement, but is also one of the most striking peculiarities of those suffering from the milder forms of functional brain trouble. The above applies particularly to the first stages of brain exhaustion. There is no doubt that in those of sound mind the emotions are capable of being very largely controlled by the will; not only this, but there is strong evidence showing that the emotions, besides being subject to the counteracting influences of the will, are actually capable of being more or less completely suppressed by it.

In those suffering from functional brain disorders the above applies to a far less degree. This is particularly

true of those who, having suffered from worry and overwork, at length become the victims of a greater or less degree of exhaustion of the centers of ideation (and emotion).* Such persons are aroused, by even the most trivial circumstance, to the exhibition of an amount of emotion utterly out of proportion to the magnitude of the exciting cause. Sometimes the emotions assume the form of violent anger, which an insignificant circumstance is sufficient to evoke; at others, the subject suffers from sudden, unaccountable attacks of depression, which a constant habit of morbid introspection only serves to aggravate. By degrees the morbid mind becomes absorbed entirely in itself, and gropes about in quest of some cause which shall adequately account for the disagreeable impressions. The most trivial circumstance is eagerly interpreted as the real cause of the trouble. If a slight pain is felt in the right hypochondrium, then he has the "liver complaint." If an acquaintance chance to pass him in the street without exchanging the customary greeting, then forthwith the conviction becomes established that his conduct must have something unusual or improper in it, and that society, having become conscious of his idiosyncrasy, is inimical to him. Thus, by degrees, a positive dread of his kind is engendered. It is thus that a whole host of morbid fears† has its origin. It is true that it may not always be possible to trace out the primary ætiological factors in

* The centers of ideation and emotion have been regarded as separate entities by some, while others consider them identical. The latter view seems to me the most probable.

† *Vide* "Neurasthenia," by Dr. G. M. Beard.

these cases, as the latter are often remote, and the patient himself can not always give a chronological history of his trouble. But I am convinced that, if it were possible to obtain all the facts in such cases, the primary source of the morbid, hypochondriacal manifestations would be found to consist in some functional decrepitude of the ideational centers, consequent upon excessive sanguineous irrigation, or irritation of the cerebral substance.

An interesting case, illustrative of the more or less permanent morbid emotive condition engendered by congestion of the higher centers, is related by Hammond.* "A person of my acquaintance had his whole character changed by a slight attack of cerebral congestion. Naturally he was of a good disposition, amiable in his character, and considerate in his dealings with others; but, after a vertiginous seizure, attended with unconsciousness of but a few moments' duration, his whole mental organization underwent a radical change; he became deceitful, morose, and exceedingly overbearing and tyrannical toward all with whom he came in contact and whom it was safe for him to maltreat. His likes and dislikes were entirely reversed in many important instances." Such cases are interesting, not because of their rarity, but rather on account of the frequency of their occurrence, and also because of the importance which they possess from a possible medico-legal standpoint. Moreover, there is a large class of cases variously designated as "nervousness," "hypochondria," etc., which are directly traceable to some such recent or remote anomaly of the cere-

* *Op. cit.*, p. 24.

bral circulation, or to the effect of some sudden emotional disturbance, disregarded, perhaps, at the time, but quite sufficient to permanently maintain the state of central irritability. It would be of great interest to ascertain, by a sufficiency of statistics, how far such circulatory anomalies are responsible for the permanent vascular changes found in general paralysis and epilepsy. Considerable speculation has been indulged in on this point, but more adequate statistics are required. It is interesting, however, to note that the majority of circumstances which have been assigned as the predisposing causes of general paralysis are such as produce demonstrable effects upon the cerebral circulation—tobacco, alcohol, etc., etc.

The moderate indulgence in a certain class of emotions is not only perfectly in accord with the exigencies of health, but is actually conducive to it. Thus the complicated chain of emotions engendered by music is often highly beneficial to those whose brains are subjected to the strain of worry and excessive intellectual effort.

There is, however, a class of emotions the indulgence in which is fraught with danger to the thinking apparatus; they constitute, in a word, one of the most prolific sources of insanity. In this category belong anger, extreme forms of jealousy and disappointment, and the complicated group of morbid emotions known as worry. The group of physical symptoms peculiar to anger are most interesting, on account of the clew which they afford to the real cause of the baneful effects produced by an excess of this emotion.

The phenomena exhibited in an extreme paroxysm of anger are the following: The countenance assumes a distorted and repulsive appearance, owing to the action of the orbicularis oris, the corrugator supercilii, and the masseter muscles. The spasmodic contraction of the latter lends a cold, hard appearance to a picture already sufficiently repulsive. Some observers will have it that there is a "glistening" of the eye. But I believe, with Darwin,* that the muscles surrounding the eye (orbicularis palpebrarum, etc.), as well as the facial muscles, are far more responsible for this appearance than any changes within the globe of the eye itself. In the first instance the cardiac and respiratory functions are oppressed; there is an attempt to "catch the breath," while the heart almost ceases to beat. This initiatory stage of depression has sometimes been so overwhelming in its onset that the subject has fallen dead, as if smitten by a stroke of lightning. Usually, however, the first period of depression is quickly succeeded by a second reactionary stage, which is ushered in by an irresistible desire to annihilate the exciting cause. The motor apparatus becomes rigid, the hands are clenched, and the jaws fixed.

Against the influence of such a paroxysm the will is but ill-prepared, and, indeed, in many instances, absolutely powerless to contend. The available energy of the entire mental mechanism seems focused in the one hideous whirlpool of emotion, which completely ingulfs the nobler faculties and aspirations of the understanding.

* "Expression of the Emotions in Man and Animals," by Charles Darwin. New York, 1873.

There has been some disagreement among observers as to whether there is present in anger a condition of cerebral engorgement or anæmia. The truth of the matter is, however, that both conditions are present. In the first stage, owing to the depression of the cardiac and respiratory functions, the face is pale, whereas in the second reactionary period there is a violent resumption of cardiac action, and face and scalp become deeply congested. Co-existent with the period of congestion there is violent excitement of the motor and psychical centers of the brain, owing to the hyper-irrigation of those regions with arterial blood on the one hand, and to the diffusion of the shock, occasioned by the exciting cause, through the sensorium on the other. Where the irritation is very great, the psychical and motor phenomena are without co-ordination. This condition is well exhibited in children, and is also seen in various forms of insanity. If a young child be aroused to anger, the face and scalp become flushed; it rolls upon the floor, or strikes surrounding objects, whether they are animate or inanimate, or whether they have caused displeasure or not. Moreover, its protests are utterly without logical sequence, and consist in a series of inco-ordinate howls. There is a strong parallelism existing between this anger of the child and the rage of the acute maniac. In both instances the psychical and motor manifestations are without coherence or direction.

On various occasions I have had opportunities of proving, by direct experiment, that the excitement of congestive mania owes its perpetuation to the presence of

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The immediate effect of anger upon the vital functions is often most disastrous. Sweetser* cites a number of interesting cases of this class. Thus the Emperor Nerva died of a violent excess of anger, owing to an offense committed against him by a senator. Valentinian, the Roman emperor, while passionately reproaching the deputies of the Quadi, suddenly fell dead at the feet of the latter.

Where the cerebral arteries are weakened by atheroma or other disease, it not infrequently happens that a fit of violent passion is sufficient to rupture one or more vessels, and death from apoplexy results. Dr. John Cooke† relates the case of "a gentleman, somewhat more than seventy years of age, of a full habit of body and florid countenance," who, "on getting into his carriage to go to his country house, was thrown into a violent passion by some circumstance which suddenly occurred. He soon afterward complained of pain in his head, and by degrees he became sleepy, and, in about a quarter of an hour, wholly insensible. He was carried into the shop of an apothecary at Kentish-Town, and was immediately largely bled. When I saw him, about an hour afterward, I found him laboring under all the symptoms of strong apoplexy. In about twenty-four hours he died."

The celebrated surgeon, John Hunter, died from the effects of a violent fit of anger. Mr. Hunter was the victim of heart disease; and, knowing the danger of violent passions to one suffering from this species of

* "Mental Hygiene," etc., by William Sweetser, M. D. New York, 1850.
† "A Treatise on Nervous Diseases."

physical infirmity, as well as his own liability to sudden outbursts of anger, expressed the opinion that "his life was in the hands of any rascal who chose to annoy and tease him." This prediction was eventually verified. Being involved one day in an altercation with his colleagues, one of whom presumed to contradict him in a peremptory manner, he suddenly ceased speaking, hurried into an adjoining apartment, and fell dead on the spot.*

Such examples of the fatal consequences attending the onset of violent anger, in those whose hearts are functionally or organically deranged, are by no means uncommon. The heart is not, however, the only organ affected by excessive anger. The functions of the stomach, for example, may be much affected by this passion; and it not infrequently happens that the appetite is entirely destroyed by a sudden and violent outburst of anger. In spite, however, of the manifold physical influences of anger, its most baneful effects are, as we have already seen, upon the mind. Anger is one of the most prolific sources of insanity. It is related of Charles VI, of France, that, "being violently incensed against the Duke of Bretagne, and burning with a spirit of malice and revenge," he "could neither eat, drink, nor sleep, for many days together, and at length became furiously mad, as he was riding on horseback, drawing his sword and striking promiscuously every one who approached him. The disease fixed upon his intellect and accompanied him to his death."

* *Op. cit.*, p. 147.

Where, however, violent anger does not terminate in severe mental derangement, it frequently results in the production of a state of permanent irritability, which renders the cerebral mechanism particularly liable to the inroads of functional disorders. Even where resentment is less acute in its manifestations, and assumes the detestable form of revenge, there is no little likelihood that the condition of chronic erethism thereby established in the intellectual and emotional centers may result in more or less functional injury, or even severe mental derangement.

The chronic form of anxiety known as "worry" is one of the potent causes of functional cerebral disorders and permanent mental trouble. Strictly speaking, worry is not a simple emotion, but is, in the majority of cases, compounded of a variety of passions. Thus, the worry occasioned by pecuniary loss may involve fear of individual degradation, loss of the comforts of life, and the dread of actual misery. Or anxiety for the welfare of others may be conjoined to the fears of strictly individual misfortune, as in family disasters. But as these subjects will be referred to somewhat at length in a subsequent chapter, it would involve needless repetition to enter upon their further discussion in this connection.

Enough, however, has already been said to show the paramount importance to mental health of a rational hygiene of the emotions.

IV.

MEMORY IN ITS HEALTHY AND MORBID RELATIONS.

As disorders of memory are among the most frequent manifestations of functional brain trouble, it is well to form some estimate of the nature of this faculty of the mind in order to arrive at just conclusions respecting its clinical importance. The essential feature of what is termed memory is the ability of the sensorium to hoard up impressions and to reproduce the same when the primary stimulus which gave rise to the impressions is no longer present. This ability of the cell to retain impressions—this mental photography—is far more developed in youth than in the later years of adult life. But we know that the cell, like the living being, has a life and a death, and that at its death new cells spring into being. Now, how is it, then, that, if the cell die, those impressions which it retained during its life are perpetuated? Luys* has given an answer to this question which appears to me both plausible and ingenious. He says: "It is, then, probable that the primordial-cells, which give birth to all the generations of daughter-cells that appear in the course of

* "The Brain and its Functions," by J. Luys. New York: D. Appleton & Co., 1882.

cerebral development, transmit to their descendants the special sensitive properties, the specific degrees of phosphorescence, with which they were animated at the moment of their origin; and that it is in these intimate connections between cell and cell, in these mysterious bonds of relationship, that we must look for the secret of the perennial character of certain memories." Although there is nothing particularly new in the idea of cell-heredity, the application here made of it is, at all events, plausible, and preferable to any amount of ordinary cerebral metaphysics.

Youth is pre-eminently the period of mental absorption. First come the observations of very early childhood, which, constantly repeated, are at length hoarded away in the sensorium, and finally become fixed entities. Later come co-ordinated and more abstract impressions, which are the result of the symmetrical development of the mental mechanism and intellectual life of the individual. The comparatively automatic impressions engendered by mere external objects give place to a higher and more complicated registration, and at length memory no longer finds itself the mere recorder of objects and barren forms, but rather the register of the highest and most abstract ideas of the understanding.

Repetitio mater est studiorum is an adage of the days when conceptions of intellectuality were closely allied to the functions of the encyclopædia and quiz-master. In those good old days the mechanical storage of impressions in the safety vaults of the memory played a far

greater part than now. Books of reference were scarce, and every man was in a measure his own encyclopædia. But the idea that the repetition of impressions is the fundamental principle of effective memorizing was correct. In order that the impression of a certain set of sounds or colors shall be permanently retained in memory, it is necessary that the impressions themselves shall be often repeated. Hence an active *impressionable* condition of the peripheral sensory apparatus is one of the prime conditions of a good memory. In addition to this, however, it is equally evident that the central ganglionic apparatus must maintain itself in a *receptive* attitude toward the impressions which arrive through the medium of the peripheral mechanism. There must be, in other words, an active, harmonious union between the apparatus which received the primary stimulus from the external world and that which appropriates and retains the same in a permanent and available form. "Thus it is, then, that external impressions of all kinds, the diverse emotions we have felt, become finally attenuated in the plexuses of the *sensorium*, and, in the form of persistent vibratory thrills, become the posthumous expressions of impressions and past emotions which remain alive in us when the primordial excitations have long ago disappeared." *

This is certainly very picturesque language, and in the main serves to express the proper psychological idea. Instead of "persistent vibratory thrills," however, it seems to me that it would be more in harmony with a

* *Op. cit*, p. 147.

true conception of the nature of the psychical process to say: *in the form of revivable impressions.* This excludes the sufficiently questionable assumption of "persistent" protoplasmatic vibrations—a conception which, followed to its logical sequences, would be at variance with what we know concerning the functional periodicity of the higher centers. Reminiscences are difficult to conceive of "in the form of persistent vibratory thrills." On the contrary, we have to do with latent, revivable *impressions* —not active "vibrations." It is nothing short of a confusion of terms to speak of the protoplasmatic changes in the cerebrum, incident to function, as "vibrations"; and of the *state* engendered by such changes *also* as "vibrations." Memory, as we have already seen, has frequently been compared to photography—the primary impression stored away in the higher centers corresponding to the faint image produced by the rays of light upon the sensitized plate. The subsequent incidental impressions which revive former "latent" impressions have been compared to those chemical agents which "bring out" the faint tracings upon the sensitized plate. This is about as accurate as most analogies.

One of the fundamental truths connected with the power of reminiscence is the great influence exercised by an association of ideas upon the faculties of retention. This is well shown in conjunction with certain geographical names. Africa means nothing to the lad who encounters the name for the first time among a number of other non-descriptive designations, and is soon forgotten. But if he can bring the name into juxtaposition

with a description of the continent and its inhabitants, then the term becomes a living reality. The appearance of a negro, the sight of an elephant at a menagerie, or the mention of the Zulu war, are sufficient to call up the whole sociological conditions of the country. The same principle holds true with regard to language, the use of which necessitates a more or less constant appeal to the highest resources of memory. To acquire German at home is no easy matter; but, brought into association with Rhine wine, the thing is perfectly simple!

The employment of figurative methods of speech is nothing more than an appeal to a more complex association of ideas. Take from the brain the power of co-ordinating impressions apparently but little associated, and there is an end to all imagination. It is indeed the imagination which lends power to language, which "puts windows into style." Nothing is more absurd than to suppose that perfection of expression is to be obtained either through the agency of an automatic assimilation of words, or by means of the inquisitorial shifts of the quiz-master.

The degree to which the power of memory is developed in some individuals borders on the marvelous. Thus, instances have been known in which persons have succeeded in repeating, word for word, the contents of whole volumes. Napolean Bonaparte had a prodigious memory for dates and minute circumstances of history. Daniel Webster is also said to have been gifted with an unusual memory. The cultivation of the memory formed an important part of the training of the orators

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Deterioration of the Faculty of Memory in Functional Brain Disorders.

Among the very earliest symptoms of impairment of brain-function are disorders of the faculty of recollection. It is therefore necessary, in the examination of every case of suspected functional cerebral disorder, to make careful investigation respecting the condition of the memory. Not only should the subject's power of remembering past and recent events be tested, as recommended by some writers, but careful inquiry should also be instituted as to whether memory for place, names, dates, written or spoken language, is in any way affected.

In such investigations as the foregoing it would be great matter of convenience if we had some general normal standard with which to institute a comparison. Unfortunately, however, as already seen, the faculty of recollection is an exceedingly variable quantity even among those whose intellects, judged by the conventional standard, are healthy. Under these circumstances the best we can do is to compare the subject's present ability of retaining impressions with his previous aptitude of recollection. And, although this method of examination does not possess the "ideal" features sought after by certain theoretical alienists in connection with the examination of those of unsound mind, it will nevertheless be found to afford excellent results in practice.

Subjects afflicted with cerebral exhaustion, morbid fears, vaso-motor disturbances affecting the cortical blood-supply, and other functional brain disorders, frequently

exhibit impairment of the faculty of recollection of the most varied character. Sometimes the power of attention of these patients is profoundly deranged. When engaged in conversation their eyes have a distant, "bottomless" appearance, and their observations show that they are oblivious to the particular subject of discourse. They interrupt the conversation of those with whom they may happen to be conversing with the most unaccountable observations—remarks wholly at variance with the particular subject under discussion. Owing to this mental irrelevancy, impressions from the external world have no time to become fixed. Hence the auditory impressions of but a moment ago, though distinctly heard at the time, leave no permanent imprint, and are almost immediately forgotten. The same may be said of optic impressions, though to a more limited degree. And it may be also remarked in this connection that the ability of receiving and remembering optic impressions to a better degree than those of acoustic origin, which is often so characteristic of children, is present in these patients to an exaggerated degree.

An instance of this kind of exaggerated forgetfulness, occurring in a gentleman who had long been a victim of brain-exhaustion, recently came under my observation. In this case the subject could not read the ordinary occurrences recorded in the daily prints without experiencing the utmost fatigue; five minutes of such reading were, in fact, sufficient to cause most violent pain at the vertex. The peculiarity of this case was that, while the subject-matter of conversation and reading was soon forgotten, as well as the most ordinary musical airs, visual impres-

sions were registered with wonderful exactness. Thus, his memory for faces became so acute that he was constantly greeting persons whom he had merely seen while passing through the streets, or while standing in the lobbies of hotels or other public places of resort. So troublesome did this habit become that society, already sufficiently distasteful, was finally relinquished altogether. In order to avoid seeing and being seen, he was in the habit of leaving his rooms only after dark; and ultimately a positive dread of his kind was developed.

Sometimes the occurrences of the early years of life are remembered with great vividness by those suffering from functional cerebral disorders, while more recent occurrences leave but slight impressions, or are forgotten altogether. Sometimes, however, the memory for both recent and remote events is impaired. Of these disorders of memory occasion will be had to speak more specifically in connection with the clinical characteristics of brain exhaustion.

Memory, like volition, is a variable quantity, even in the same individual. There is something very significant in these fluctuations of memory; and, when accurately studied, they are found to constitute a species of barometer of the sanitary condition of the mind. Deterioration of the faculty of recollection is one of the earliest indications of grave mental disorder. Depleting excesses, or such as tend to an exhaustion of the cerebral centers of the brain, manifest themselves by an immediate deterioration of the faculty of recollection. The above is particularly true of venereal excesses.

The inordinate abuse of tobacco and alcohol also exercises an extremely detrimental effect upon the memory.

Senility is another potent cause of defective memory; in very old persons the power of perception, as well as the faculty of permanent registration, is impaired. The superior ability of remembering the occurrences of early youth peculiar to very old persons is attributable to the indelible nature of those impressions, owing to the greater receptive capacity possessed by the young brain. Recent occurrences are readily forgotten by the aged, because they are tardily and imperfectly perceived, owing to the deteriorated condition of the peripheral sensory apparatus, and by reason of the blunted receptivity of the ganglionic centers.

The evolution of memory is gradually achieved under normal conditions; its decline should therefore be equally gradual, all things being equal, and in harmony with the slow development of the processes of senility within the brain-cell.

CLINICAL AND PATHOLOGICAL.

V.

BRAIN EXHAUSTION.*

UNDER this designation I propose to consider a group of clinical phenomena, the chief feature of which is *a morbid limitation of the ratiocinative capacity* of the individual, consequent upon functional brain disease.

The manifestations of cerebral exhaustion are chiefly comprised under the following headings:

Psychical Symptoms.	1. Morbid Limitation of the Ratiocinative Processes. 2. Morbid Emotional Phenomena. 3. Derangements of Memory. 4. Volitional Impairment. 5. Evanescent Mental Confusion. 6. Disorders of Sleep—Morbid Dreams. 7. Lack of Mental Concentrativeness.
Physical Symptoms.	8. Ocular Symptoms. 9. Acoustic Symptoms. 10. Vaso-motor Disturbances and Cardiac Derangements. 11. Local Head-Pains.
Secondary Symptoms. *Sometimes* consecutive to the primary exhaustion.	12. Insufficiency of Voluntary Muscular Power. 13. Morbid Fears. 14. Lachrymose Condition in the Male, wrongly called Hysterical. 15. Morbid Sexual Manifestations.

*The basis of this chapter is my paper on "Cerebral Exhaustion," read before the Medical Society of the County of New York, and published in the "New York Medical Journal" of December, 1883.

Psychical Symptoms.

Morbid Limitation of the Ratiocinative Processes.— The first symptom which is usually noted in these cases is great restlessness during the day and more or less wakefulness at night. Sometimes, however, there is great drowsiness in the beginning of the attack, especially during the day. Persons thus afflicted complain that they do not thoroughly awake till after mid-day. Soon the disturbance becomes greater; pains are felt in the region of the vertex, above the superciliary arches or at the upper portion of the neck. The cervical pain is, however, far less constant than the head-pains. Even the slightest mental exertion is sufficient to bring on the vertical or frontal head-pains. The ratiocination incident to ordinary conversation and reading is absolutely unendurable to these patients. A gentleman recently came under my observation who, after reading the newspaper for only five or six minutes, is attacked by most intolerable vertical pain, vertigo, and confusion of ideas. If spoken to at such times, he has the utmost difficulty in co-ordinating his ideas, and the replies which he gives on these occasions furnish ample evidence of the state of mental confusion. This confusion is of slight duration and soon passes off; its evanescent nature, indeed, constitutes an interesting characteristic. There is no loss of consciousness.

Sometimes the abnormal mental fatigue is exhibited in the operation of writing. The subject attempts, for example, to compose a letter, but soon finds that his fac-

ulties are entirely unequal to the task. There is confusion of ideas, the wrong words are used, letters are omitted or misplaced, sentences are altered and re-altered. A severe pain is gradually developed at the vertex or over the eyes; objects become indistinct, and finally the task has to be given up altogether. Where the intellectual operation is mathematical in nature, such, for example, as footing a ledger, the subject experiences the utmost difficulty. A column of figures is half added up, when the last number is forgotten, and the operation has to be begun over and over again. The repeated efforts incident to the undertaking becomes at last intolerable. Excessive irritability is developed; sleeplessness at night and drowsiness during the early portion of the day combine to further demoralize the mental economy, and at last even brief mental effort is found to be unendurable.

Morbid Emotional Phenomena.—Next in importance to the specifically intellectual symptoms are the emotional disturbances to which these patients are liable at the beginning of the attack, and, indeed, throughout the entire duration of the disease.

Trivial disappointments and losses are magnified to an inordinate degree. Insignificant occurrences, such as subjective sensations of discomfort, temporary depression of spirits, indignation, or the failure to attain some unimportant end—things, in short, which under normal circumstances would be totally disregarded, are magnified a thousand-fold, and give rise to frequent outbursts of uncontrollable anger. This extreme irritability is one of

the most characteristic features of the disease, and is absolutely beyond the control of the patient. When laboring under an attack of this peculiar form of anger he is capable of perpetrating the greatest extravagance, and may be extremely violent and abusive to those about him. These paroxysms of anger may be extremely brief in duration, or may continue for several hours. During their continuance the subject manifests a morose and sullen attitude toward all with whom he may be thrown in contact. Sometimes he is revengeful, and concocts extravagant and fantastic plots against those who are supposed to be inimical to him. At others he is lachrymose, and disposed to look upon himself as a martyr—as one misunderstood by his fellow-mortals.

I have remarked that these manifestations usually come on toward evening, and that they are materially aggravated by the use of coffee and tobacco. Tea, on the contrary, seems to be of benefit. But of all remedies with which I am acquainted, the extract of coca is the best for dealing with this condition of irritability—not excepting the bromides. It has the soothing effect of the latter remedies, but without their characteristic depressing influence. The preparation of coca known as Mariani's Coca Wine is, so far as I know, the best in the market. It possesses the decided advantage of being manufactured from the fresh leaves, which, if we are to believe the accounts of travelers who have investigated the specific effects of the leaf in South America, is an indispensable requisite. The period of extreme irritability is almost invariably succeeded by more or less

severe depression. This secondary melancholia may be sufficient to provoke active attempts at suicide. Usually, however, it gradually abates in severity; but it is a noteworthy fact that a certain degree of depression is rarely absent in these cases during the entire duration of the disease.

Derangements of Memory.—The faculty for registering impressions is often materially deranged. Sometimes the names of familiar places, persons, and objects are forgotten. At others, the simple ideas occurring in ordinary conversation are not retained. This latter type of forgetfulness resembles in many respects that form of the disorder found in old age. Sometimes the memory for past events is affected, but by far the majority of cases exhibit defective recollection for recent occurrences.

In some instances of exhaustion these derangements of memory are among the first symptoms which excite the apprehension of the subject. They constitute an extremely annoying feature of the disease, giving rise to no end of trouble.

In the chapter on Memory reference has been made to aggravated forms of this symptom.

Volitional Impairment.—The will exhibits in this, as in various other forms of functional derangement, marked impairment. Such operations as are incident to the vocation or social life of the individual are performed in an indifferent and perfunctory fashion, in spite of a strenuous desire on the part of the subject to exercise his volitional faculties to some effect. Nor does this state of things arise alone from an inability on the part of the exhausted in-

Local Head-Pains.—In the large majority of cases these are located at the vertex or over the eyes. They are usually dull and heavy, but are sometimes of a "rasping" nature. Particular care should be exercised not to confound them with the characteristic "splitting" pains of syphilis. These local pains are aroused and intensified by even slight efforts at intellectual work. Thus, I have seen an attempt at reading of only five minutes' duration produce most severe vertical pains and dizziness in a gentleman suffering from an acute attack of cerebral exhaustion. The peculiar *aged* appearance often seen in cases of brain exhaustion was particularly well marked in this patient; there was also an *inordinate craving for stimulants*—a very characteristic symptom. Emotions of a disagreeable character—such as worry, disappointment, and chagrin—are prolific sources of the form of local pains just referred to. The application of a sponge saturated with hot water over the painful spot is often sufficient to cure these headaches, particularly the vertical variety. Before proceeding further, it may not be out of place to give a brief synopsis of a case or two by way of illustration.

The following cases are condensed from my note-book:

P. C., an American gentleman, aged fifty-six years, single, resident of the northern part of the State of New York, came under my observation some months since. In 1876, patient was very much engrossed in business. Employed his intellectual faculties from early in the morning till far into the night. Was obliged to do this

in order to keep the books of the firm in proper order. Became very irritable at this time, was averse to society, and began to avoid his friends. Sleep became poor, and recourse was had to copious stimulation, with the hope of improving it, but without benefit. Was finally obliged to give up night-work, and sleep improved somewhat. Lost flesh, however, for the next three years, so that in 1880, at the solicitation of friends, he consulted a neurologist of reputation with regard to his condition. What the exact nature of the treatment was, as prescribed by the medical gentleman in question, I have been unable to ascertain. The patient states, however, that he experienced no benefit.

In July, 1883, he consulted me with regard to his condition. At that time he was a sufferer from frequent attacks of acute indigestion. Sleep poor. Bowels constipated. Skin dry. Expression of countenance haggard. "Bottomless" and lifeless appearance of eyes well marked. Contraction of pupils moderate. Tongue coated and slightly tremulous. Had employed his intellectual faculties to an immoderate degree for some time past, and had been much worried about his business. Of late he had been troubled by pains at the vertex, noises in the ears, and by sudden attacks of facial pallor accompanied by vertigo. His memory for recent events had become poor. But the most pronounced symptom was his total inability to continue for over a few minutes any species of employment requiring thought. Reading and writing were absolutely impossible, and even conversation for over fifteen or twenty minutes produced severe

frontal headache and mental confusion. The circulatory anomalies were not especially well marked in this case. There was extreme irritability, and an uncontrollable tendency to become enraged at trifles.

Sometimes, especially when conversing about his mental condition, he would burst into alternating paroxysms of laughter and crying.

An amelioration of the insomnia, combined with hyper-nutrition and moderate exercise, produced a wonderful improvement in the condition of this patient; but it was impossible to induce him to abandon the use of alcohol. The stomachic difficulties are among the greatest obstacles to be encountered in the treatment of these cases. Fortunately, they are by no means a constant factor.

Before this patient's cure was entirely accomplished I lost sight of him, and can not therefore state what was the ultimate result.

M. E., American, aged thirty years, usual weight in health about one hundred and fifty pounds. Has followed various professions. While at college, enjoyed good health; joined in the athletic sports, and became a good oarsman. Took especial pride in his muscular development, which was above the average. Did not, however, neglect his studies, but, on the contrary, was very punctilious in the discharge of his academical obligations.

After a time, however, sleep became poor, and, having passed an examination which had caused him much worry, he noticed that his memory was not as good as

formerly. Even moderate mental work caused pain at the vertex, confusion of ideas, and vertigo. Was troubled by immoderate drowsiness during the early morning hours.

Went abroad shortly after this, and, while absent, experienced improvement in health. On his subsequent return to this country he began the study of a liberal profession, and soon experienced a renewal of the former symptoms. Sleep became much deranged, appetite was poor, and the digestive functions were considerably deranged. His mental faculties became "dull," and he was incapable of protracted intellectual labor of any kind. There was marked impairment of venereal power. In the morning he was dull and stupid, whereas later in the day he frequently suffered from mental exaltation. When laboring under these attacks he would sometimes attempt to put his thoughts upon paper. Some of these compositions were submitted to me for inspection, and I found them to consist of a series of extravagances which, though coherent enough in themselves, were utterly at variance with his usual mental habitude. Indeed, he confessed to me that he never could have written them except when laboring under the influence of these attacks of morbid exaltation.

The above was substantially his condition some months before he came under my observation, and there was practically no change in his physical and mental health when I saw him, although he had undertaken extensive journeys to various parts of the country with the object of improving his health.

I put him upon beef-juice and milk, and, by degrees, as his digestion improved, soft boiled eggs were added, with a moderate quantity of dry bread. Later he was able to take tender beefsteak very finely hashed.

Before retiring, I ordered a douche of warm water over the entire body. His feet, which were habitually cold at night, were placed in a hot bath after the douche had been taken, and, when they had been thus immersed for the space of from five to ten minutes, were carefully dried and wrapped in flannel. While taking the foot-bath the patient was carefully enveloped in blankets, but not to such a degree as to cause profuse perspiration. This plan worked so well that there was soon a wonderful improvement in sleep. During the first four weeks I used the bromides during the day, in conjunction with moderate doses of chloral at night; but at the end of the seventh week he was able to sleep without the aid of either of these remedies.

A small wine-glass of Mariani's coca-wine three times a day was ordered shortly previous to the fourth week, and this remedy was continued up to the end of the ninth week.

Ultimately this patient was able to sleep about thirteen of the twenty-four hours, and his appetite showed marked amelioration.

There was a considerable gain in weight, but not as great as I have seen in some cases.

No local galvanism to the head was used in this case, as the patient had tried electricity in every form without result, and had contracted a positive antipathy for it.

During the whole of this treatment complete cessation of mental work had been maintained, in spite of the fact that he had succeeded in obtaining more sleep than for many years past. Reading and writing were entirely given up, and even protracted conversation was enjoined.

The most potent influence in maintaining such a state of apparently impossible quiescence was the coca. It is impossible to say too much in praise of this wonderful remedy; but the first condition to its effective employment is that it shall be skillfully prepared from the fresh leaves; and I believe that the proper treatment of these latter is a matter which exacts no little amount of tact and experience. The dose is another important feature, and must be regulated according to the constitutional idiosyncrasies of each patient. Coca possesses this great advantage over the bromides, that it does not exercise the depressing influence which is so characteristic a feature of the latter remedies. It serves to adjust the individual to the exigencies of his environment to a far greater degree than any mere fiat of the will; and where the latter is enfeebled, as it is in very many of these cases of cerebral exhaustion, coca is an invaluable resource in treatment. I do not, however, wish to detract in the slightest degree from the deservedly high esteem in which the bromides are held by the profession. On the contrary, my only desire is to draw attention to the specific excellence of a remedy which is now beginning to excite the interest of clinicians, both in this country and abroad, but which also, for some unaccountable reason, remained for a long time utterly neglected.

After treatment had been continued substantially as above described for about three months, the patient left for the West, apparently entirely restored, both mentally and physically. He could read and write for several hours a day without trouble; the irritability had almost entirely disappeared, and he was able to again begin the active duties of his vocation.

I have not heard from him since, but do not doubt the permanency of his cure, provided that there has been no resumption of his former intellectual excesses.

A. V. C., a lady of literary habits, aged thirty years, married, has had children, one still living and healthy, wrote me from Europe an account of her condition, which is at once so graphic and interesting that I can not do better than give a brief synopsis of its more prominent features. Six years ago (one year after birth of last child) patient became considerably prostrated, both mentally and physically, but recovered, apparently, after some months, and continued well until 1881. During this year devoted herself to charities of various descriptions, as well as to society. By degrees her duties increased to such an extent that, as she graphically expresses it, she became involved in a "tornado" of mental work. To make matters worse, her husband, who has always been extremely devoted, suffered heavy pecuniary reverses, which caused her an excessive amount of mental worry. Sleep became much deranged. During the beginning of the night she was extremely restless, and beset by disagreeable dreams; in the morning, on the contrary, sleep was unusually profound. On awak-

ing, her condition was characterized by mental lethargy and extreme physical prostration. During the summer of the same year she appeared to rally somewhat, but toward the latter part of September, having again overexerted her intellectual faculties, she suffered a relapse of such severity that, in her own language, she was unable to put her foot to the ground. Her mental prostration was so great at this time that she was unable to read even a line of print. The reading of a letter caused her to feel "as if struck upon the top of the head with a club." When, somewhat later, she attempted, in spite of various disagreeable sensations in the head, to read the newspaper for only a few moments, her heart was thrown into a state of violent palpitation, which lasted for days.

Her condition during the past eighteen months has been substantially as follows:

Mental Condition.—Her memory, which has been very poor, has begun to show a little improvement. She can read for about five minutes at a time, but, if an attempt is made to increase this brief period of intellectual occupation, vertigo and intense vertical pains are the result. Conversation, on the contrary, is possible for about half an hour at a time without great inconvenience. When she attempts to walk for more than fifteen minutes she experiences violent pains in both parietal regions. There are, however, not the slightest sensations pointing to muscular fatigue. These head-pains, consequent upon voluntary muscular movements, are by no means always found in cases of cerebral ex-

haustion. Where they do occur, they are commonly supposed to be the result of muscular fatigue. I can not, however, agree with an opinion, which seems to me directly opposed to the observation, that these head-pains occur after an exercise of volition in the absence of all symptoms of paresis or muscular fatigue. These local head-pains seem to me, therefore, far more indicative of a certain degree of exhaustion of the voluntary motor centers in the cortex than of general muscular fatigue. Moreover, the fact that they are relieved by remedies which exert a specific tonic and soothing influence upon the centers of volition and ideation, such, for example, as coca, goes far to support this view of the question. I have besides observed that massage is without effect in such cases when deprived of the therapeutic co-operation of specific cerebral treatment (rest, hyper-nutrition, tonics, etc.).

The function of sleep still continues to be profoundly deranged. Sometimes it is heavy, "as if drugged"; at other times it is light, and troubled with dreams. These dreams are sometimes of a pleasant nature, but quite as often they are frightful.

The entire category of the bromides—chloral, hyoscyamus, opium, alcohol, etc.—have been employed, with the hope of relieving the insomnia, until only very large doses produce the slightest effect. Electricity has also been tried; and, although administered by an electrician of celebrity, she has experienced little or no benefit, and, indeed, has contracted a positive repugnance for this form of treatment.

She is very irritable, and easily excited, by even the most trivial circumstance, to a pitch of anger bordering on ferocity.

This patient has been seen by six of the leading physicians of Europe, who all agree that she has no organic trouble, but are unable to render her any assistance.

There has been considerable gain in weight; but this gain is not owing to any augmentation of muscular tissue, but rather to an accumulation of that flabby kind of fat peculiar to anæmics.

Massage is indicated in such cases; but, as before observed, in order to be effective, it must be accompanied by treatment directed to the supply of the specific requirements of the exhausted brain. Those requirements are (1) rest, (2) nutrition, and (3) tonics (cerebral).

It is too early as yet to speak of the results of treatment in this case. My primary object in citing it was, however, not to exhibit therapeutic results, but to illustrate first the possibility of the occurrence of cerebral exhaustion in women (doubted by some); and, secondly, because it affords an admirable illustration of the concomitant exhaustion of the voluntary motor centers.

Cerebral exhaustion is, indeed, far more common in men than in women; but this is attributable to the fact that women are less exposed to the peculiar excesses, worries, and varied mental strains which are such prolific sources of this variety of functional brain trouble.

Besides the symptoms already enumerated, and which I have sought to systematize as far as possible, there is

another category of phenomena, which, for the sake of convenience, I have termed secondary, as they are by no means constant accompaniments of cerebral exhaustion, although *sometimes* consecutive to the primary state of exhaustion. I am fully aware that my position in this regard will be questioned by those who obstinately insist upon grouping all the heterogeneous manifestations of functional nervous disorders under such a sweeping designation as "neurasthenia." But I am compelled to take issue with such strange pathological conceptions. To call the most diverse gastric symptoms "stomach nervousness"; to speak of extremely divergent symptoms of functional derangement of the spinal cord and brain as "cerebral neurasthenia" and "spinal neurasthenia," respectively, seems to me, to say the least, questionable pathology. If the symptoms designated by such sweeping terminology really represented the exhaustion of the dynamical capacity of the cell in the spinal cord and brain, then there would be less cause for complaint, and a certain clumsy consistency would be recognizable in the arguments of the advocates of such generalizations. As the case stands, however, the spectacle is witnessed of an attempt on the part of some observers to include under one common designation a host of symptoms, the heterogeneous nature of which absolutely precludes the possibility of a homogeneous origin. Erb * has been fully alive to the chaotic nature of the method at present in vogue of classifying functional affections of the cord and brain.

* "Neurasthenia Spinalis," by Professor Wilhelm Heinrich Erb. Ziemssen's "Cyclopædia," vol. xiii, p. 369. American edition, 1878.

Some years ago this gifted writer drew attention to the necessity of more consistency in this matter, particularly with respect to functional derangements of the cord. Since then, however, progress has not been as rapid as the state of the case would seem to warrant. Nevertheless, something has been gained in the direction of a more consistent codification of symptoms.

The symptoms which are about to be enumerated have been placed to the account of "nervous exhaustion" by many of the followers of the late Dr. G. M. Beard.

While perfectly willing to admit that these conditions are sometimes found in conjunction with exhaustion of the centers of the cord or brain, or both, I feel compelled to maintain that *some* of them may exist perfectly independent of any concomitant or previous state of *exhaustion* of the central nervous system.

This is particularly true of the extensive group of Morbid Fears. These latter delusions are often found in individuals of otherwise healthy intellects—persons who are frequently able to perform as much intellectual work as those in perfect mental health. I have also found a distinct "hysterical" or lachrymose condition existing in the male as the result of excesses, and perfectly independent of any previous state of exhaustion of the cerebral nervous system. It is true, however, that this *latter* condition in particular is frequently more or less connected with cerebral exhaustion.

VI.

MORBID FEARS, OR THE INCIDENTAL HYPOCHONDRIACAL ACCOMPANIMENTS OF CEREBRAL EXHAUSTION.

UNDER the above heading I propose to discuss briefly certain delusive opinions, which are sometimes associated with a greater or less degree of cerebral exhaustion, but which, nevertheless, *may* exist independently of all symptoms of exhaustion. When an individual, either by dint of extreme mental exertion or excessive worry, has set up a condition of cerebral irritation of a more or less persistent character, an interesting series of mental symptoms is frequently developed. The first of these to attract attention is a marked difficulty experienced by the subject to accommodate himself to his surroundings. Slight irritation provokes sudden resentment and outbursts of anger altogether out of proportion to the magnitude of the exciting cause. Nothing is in accord with the disjointed philosophy of such persons; friends, foes, success and failure, are merged in one heterogeneous mass of ill-omen. Those who formerly enjoyed nothing better than the society of friends suddenly conceive a positive dislike for social intercourse of all kinds, abandoning themselves to the influences of

their own pessimistic reflections. Sometimes the degree of depression is very considerable, and the absence of the healthy, reactive influences of society throws the subject entirely upon the resources of his own morbid reflections. The mind, instead of being occupied with external objects, turns to itself for inspiration, and, owing to its morbid conditions, evolves a host of gloomy forebodings. By reason of the isolated position of the subject with respect to his surroundings, as well as on account of the morbid habit of introspection, a tendency is developed on the part of the mind to undue concentration. Matters of slight account, such as a temporary attack of indigestion, or even a slight cold, are greatly exaggerated with regard to their possible significance to the subject himself. If he has an attack of laryngitis, he is convinced that his lungs are the seat of organic disease; should he feel a slight pain in his right side, then his liver is involved; and if by chance he experience a pricking sensation in the soles of his feet or a slight pressure about the thorax, then straightway he draws the conclusion that locomotor ataxia is impending. Hypochondriacs are usually great egotists, not by inheritance, nor yet from any defect of education, but rather by virtue of the morbid intellectual habits which originated primarily in some occult but real decrepitude of the mental mechanism itself. It is an interesting fact, however, that the victims of hypochondria rarely look to their own brains for the explanation of their morbid sensations. And yet, as already noted, the form of delusion which we are here considering is the outgrowth

of a greater or less degree of functional cerebral disturbance.

The form of brain exhaustion with which the hypochondriacal symptoms are *sometimes* associated is not usually, however, of so severe a nature as the variety with which we have already become acquainted. There may have been no very considerable loss of mental power; the circulation may not have been visibly disturbed; and yet a previous history of excessive mental strain, with subsequent insomnia, irritability, headache, and matutinal lassitude, is sufficient to warn us that we have had to do with an overstrain — a morbid fatigue of the thinking mechanism—if not with positive chronic exhaustion. Sometimes the morbid brain fatigue persists side by side with the hypochondriacal symptoms; but quite as often, when the subject is examined, the primary condition of mental exhaustion is found to have disappeared, and we have before us the spectacle of an apparently healthy individual complaining of various diseases, no traces of which can be discovered. If, however, instead of paying heed to every region of the body which the subject confidently believes is the seat of disease, we question him respecting his previous mental habits and condition, sufficient data will be elicited, in many cases, to put the primary existence of a certain degree of morbid brain fatigue beyond question. The history of these cases frequently reveals the exciting cause to be either mental worry or overexercise of the thought mechanism, or both of these factors combined. Thus, a student came under my care

recently who had been addicted for some months to excessive mental application, preparatory to entering upon an examination for a degree in science. So great was the amount of concentration in this case that the subject was never actually free during the day from thoughts of the impending ordeal; and even his sleep was troubled by dreams in which the mental battles of the previous hours of activity were refought with all the extravagance which a perverted imagination could lend. When this patient came under my observation he had attained the coveted distinction, but had paid dearly for the privilege, having lost the power of mental work to such a degree that his friends were under the impression that he was about to become insane. An examination of his mental condition at this time revealed the following state of affairs: Memory poor, especially for recent events; had forgotten, as he said, "half the subjects" on which he had been examined; had on one occasion forgotten the number of his own house; and it not infrequently happened that the names of acquaintances were forgotten. This was significant in his case for the reason that his power of remembering names was usually most excellent. Sleep, which, as above noted, had often been troubled by dreams, had now become so far deranged that he was frequently unable to obtain more than three or four hours of troubled slumber during the night. His condition on awaking was especially interesting. While lying in bed, preparatory to rising, he would suddenly experience a feeling of "fullness" in the head, accompanied occasionally by slight sensations

of vertigo, but without the slightest loss of consciousness. At such times his whole mental nature would seem to be changed. Ordinarily of rather a sanguine and hopeful temperament, he would nevertheless at such times become plunged in profound melancholy. He was also extremely irritable, finding fault with the domestic arrangements, and showering abuse on all with whom he came in contact. His power for mental work was so far impaired that he could continue no species of intellectual occupation for more than ten or fifteen minutes at a time. But the interesting features in this case were the hypochondriacal manifestations. These latter symptoms were more or less connected with the digestive apparatus. On every other subject he was comparatively reticent, but upon this one topic his mind seemed never tired of dwelling. I learned, on questioning him closely, that, shortly before going up for examination, he had eaten a very hearty dinner with some friends, and that later he had experienced a disagreeable sensation in the right side, which at the time was attributed to indigestion. This trivial circumstance, which under ordinary conditions would have been forgotten at once, was now revived and invested with great imaginary importance, until, from constant reflection, the delusion was formed that his liver contained a tape-worm. It was perfectly useless to talk to him about the impossibility of his theory. He had purchased a small library upon the subject of human parasites, and his limited energies were expended in exhausting this unattractive branch of natural history. He supported his theory by

arguments as consistent as his fragmentary knowledge of anatomy would admit of. The means which he had resorted to in order to rid himself of this imaginary intruder were manifold in the extreme. He had taken emetics and cathartics, he had resorted to blisters and medicated plasters of all kinds, he had tried every species of electrical treatment, and, indeed, when I saw him, was wearing a kind of galvanic battery about his waist. In addition, he had tried enough patent remedies to fill a small apothecary's shop, besides consulting every charlatan of whom he could gain any knowledge. Owing to his irritability, it was impossible to reason much with him at first, and, accordingly, no immediate attempt was made to break down his delusion. Instead of using arguments, I addressed my energies to the problem of improving his mental condition. He was put upon the coca-wine, beef-tea, and raw eggs, while the bromides were given in the afternoon and early evening. At night one drachm of the tincture of hyoscyamus and ten grains of chloral were given for the insomnia, and with the result of so far improving the sleep of the patient that the evening draught was gradually reduced, and finally discontinued after five or six weeks. Under this system of tonic treatment, combined with forced sleep and hyper-nutrition, the general health of the patient was so far improved at the end of three months that a veritable revolution was inaugurated in his brain economy. I say *inaugurated*, for such cases are not cured in a week, nor a month.

The hypochondriacal manifestations are, however, by

no means always traceable to cerebral exhaustion, as already noted. In his work entitled "Neurasthenia,"* Dr. G. M. Beard has enumerated a host of cerebral symptoms, all of which, according to him, are more or less associated with "nervous exhaustion." Among these he reckons the vast array of morbid fears, to which, in common with some other writers, he has given specific designations. Now, while I cheerfully admit the great service which Dr. Beard has rendered the profession in drawing attention to these interesting and important cases of morbid fear, I can not by any means indorse his sweeping pathological conclusions upon this as well as some other points.

There is no doubt that some of these cases of morbid fear are traceable to primary cerebral exhaustion, but my experience with this class of disorders has, as I have already had occasion to remark, taught me that, in a not inconsiderable number of cases, there is absolutely no evidence of previous exhaustion whatever. Moreover, during the persistence of the delusions, some of these patients are able to perform quite as much mental work as persons in ordinary health.

Doubtless, if we could know all the factors involved in such cases, we should find that the persistence of the morbid delusion was contingent on some minute functional change in the cortex. But such changes are, and will probably for ever remain, beyond our present methods of investigation. To attempt to explain them on the basis of the doctrine of hyperæmias or anæmais

* *Vide* on this subject "American Nervousness," by the same author.

seems to me entirely out of the question. The number of possible morbid fears seems to me practically limitless, it being apparently matter of the purest accident what particular form the morbid delusion assumes. Consequently, to give specific designations to any one category of these delusions seems to me a waste of time.

The following are some of the forms of morbid fear most frequently met with: 1. Dread of society. 2. Dread of being left alone. 3. Dread of open or secluded places. 4. Dread of responsibility. 5. Dread of contagious diseases. 6. Dread of some disease affecting a particular organ of the body. 7. Indefinable feelings of apprehension. 8. Dread of suicide. 9. Fear of accidents. 10. Fear of sudden death. 11. Fear of parasites. 12. Fear of the moon. 13. Dread of forming a decision. 14. Dread of marriage. 15. Dread of insanity. 16. Dread of dreams. 17. Fear of contamination.*

There is, in fact, practically no limit to these forms of morbid dread, the particular variety of the delusion being dependent upon the degree of education, and upon the accidental direction and concentration which some unimportant event may give to the mind of the subject.

Various writers have published accounts of individual forms of morbid fear, to the discovery of which they have made haste to lay claim. Moreover, they have endeavored to fortify their claims as discoverers by the addition of some specific and hideous designation.

* First described by Hammond.

There can, however, in the nature of things, be very little fame in such discoveries, for, as we have seen, their number is practically limitless. Exhaustion of cerebral energy, and the irritative disorders to which this condition may give rise, are often of slow growth; but, when once established, they require all the resources of a consistent and scientific system of treatment for their complete cure. The essentials of such a system are: 1. Increased sleep; 2. Increased nutrition; 3. Cessation of mental work; and 4. Time. Increased sleep, in order that the cerebral waste incident to consciousness and the processes of intellection thereby implied may be adequately repaired. This first proposition, besides being confirmed by common sense—by the usage of practice—is also supported by irrefragable arguments derived from our knowledge of the physiology of sleep. I have shown on former occasions the practical deductions to be derived from this knowledge, * and shall not repeat myself by a recapitulation of the subject on the present occasion. An increase of nutrition is desirable, in order that the lowered vital conditions found in many of these cases may be elevated to such a degree that the brain, as well as all other tissues, may be proportionately benefited. Cessation of mental work, as far as possible, is advisable, in order that the abnormal amount of waste in the brain may be checked, and the results of increased sleep properly realized. And, lastly, the element of time is of

* "Carotid Compression," Anson D. F. Randolph & Co., New York, 1882. "Brain Rest," G. P. Putnam's Sons, New York, 1883. "Sleep," "Medical Record," July, 1882.

importance, as it is a matter of experience that reparative processes within the protoplasm of the ganglia are slow of accomplishment. To admit this, however, is one thing; but to infer, on the other hand, what some would have us believe, that exhaustive conditions of the brain are incurable, is as illogical as it is untrue. My own experience in the management of these cases, however, has taught me this much: that permanent cure is far more a matter of brain rest and brain nutrition than a question of copious medication. It has been charged, and with truth, that there has been a total lack of *system* in the treatment pursued in this class of cases up to the present time. Not that the cases themselves have escaped notice, for hypochondria, in one form or other, is an old acquaintance. To tell an individual that he or she is a sufferer from brain exhaustion or the secondary hypochondria often arising from that condition, and that the "border-line" of insanity is near or remote, is one thing; but to inform him how that "border-line" is to be avoided is, however, quite another. Such information, on the other hand, is not to be embodied in the indiscriminate recommendation of one or one dozen remedies from out the labyrinth of the pharmacopœia. Medicine, as required in this connection, will only prove valuable in so far as it exerts an influence upon certain physiological principles. The bromides, hyoscyamus, and chloral have no *direct* effect upon the malady itself; but, in so far as they are necessary to the promotion of sleep, they should be given. A Turkish bath is often just as efficacious, and, indeed, is frequently to be preferred. It is

hardly necessary to pursue the discussion of this point any further. What I have mainly sought to accentuate on this occasion as well as in former writings is this: that there are no "specifics" to be directed against the actual malady itself; but, on the contrary, the energies of the physician should rather be directed to the promotion of certain great physiological principles, such as rest and nutrition, which of themselves, when properly utilized, are capable of producing the most marvelous results. When it is borne in mind that the majority of cases of insanity and other functional brain troubles begin with some derangement of the function of sleep, and that, when the insomnia which precedes insanity can be broken up, mental alienation may often be prevented, the position here taken receives support which is not to be over-estimated. The therapeutical application of sleep has been discussed by me in its various details in a monograph to which I have already had occasion to allude,* as well as the treatment of sleeplessness. I shall therefore not reopen the subject on the present occasion. Enough that the principles underlying the treatment of brain exhaustion and its consequences, and which I regard as of fundamental importance to any rational system of dealing with functional brain troubles, have been enumerated and discussed. Just in so far as the physician is able to avail himself of these principles of natural brain repair will, I believe, success be met with in the treatment of this large and important class of diseases.

Where, however, the delusion is traceable to no pri-

* *Op. cit.*

mary exhaustion or other functional trouble, the difficulties of treatment are greatly increased—so much so, in fact, that the prognosis, in the majority of instances, so far as any permanent benefit is concerned, is absolutely hopeless. These are disagreeable statements; but I believe that those physicians who have had to do with this class of cases will corroborate my opinion in this particular.

VII.

OF A CERTAIN LACHRYMOSE CONDITION IN MAN.

Besides the hypochondriacal accompaniments and manifestations of morbid dread which are often associated with, or form a subsequent accident of, cerebral exhaustion, there is another set of symptoms equally interesting if not as frequent, to which I would now direct attention. The class of cases here referred to are characterized, first, by extreme susceptibility to emotional disturbances, and, secondly, by marked irregularity in the blood-supply to the higher centers. A short description of some of these cases will afford the best insight into their clinical characteristics.

Case I.—H. E. V., reporter, employed on one of the large daily newspapers, aged thirty-five, weight one hundred and fifty-three pounds, consulted me some time since for "nervousness" and persistent wakefulness. The history of his case was briefly as follows: Three years before seeing me he had abandoned the law, for which he had been carefully prepared by study, both in the universities of this country and Europe. He had been induced to take this step from a naturally nomadic tendency of mind, as well as from impatience at the

slow progress made in his profession. From the law he went to a banking office in Wall Street, and, not content with the salary which his position there afforded him, proceeded to speculate with the slender means at his disposal, the result being the loss of every dollar which he possessed. Thus reduced, he became morbid, reticent, and averse to even the society of his intimate associates. His position soon became untenable, owing to the aversion of his brother clerks; and, after trying various occupations, he had recourse to reporting, in order to obtain the mere necessaries of life.

When I first saw this man he showed no emaciation. On the contrary, his face had a full but flabby appearance, and, when questioned with regard to even the most trivial matters, his face, neck, and ears would become flushed. I was, however, unable to note any especial injection of the conjunctivæ. He had hardly seated himself in my office when he became seized with a violent paroxysm of weeping. When I inquired what troubled him, he began to laugh and sob alternately, and finally declared that nothing ailed him, but that he "could not help crying." After a good deal of trouble, I learned that for a long time past he had been the victim of sleeplessness and more or less continual worry. To this condition was added a desultory mode of life, coupled with no little mental exertion. His dread of society had become so great that he had lost all affiliation with friends and kindred.

I can not agree with those writers who affirm that this and similarly affected patients "talk of suicide, threaten

it, but never actually attempt it." Indeed, the very patient referred to above had, on one occasion at least, actually attempted self-destruction; and I have seen the same thing in those suffering from mental exhaustion and depression, the result of overwork and worry. But to return to our patient. After a prolonged period of complete rest of the mental faculties, which he was enabled to adhere to, thanks to the pecuniary assistance of his family, a remarkable change took place in this man's entire mental as well as physical economy. Sleep became gradually much improved, and worry gave place to hopefulness. The aversion to society, however, though much reduced in intensity, never entirely left him. The lachrymose tendency, on the contrary, gradually disappeared.

Case II.—A young man, aged twenty-seven, weight about one hundred and twenty-nine pounds, came under my observation about one year ago. Had been a hard worker in his profession (engineer), often sitting up whole nights in order to complete intricate calculations. Was also much interested in invention. Thought, however, that he had never caused himself injury by this mode of life. Some time before I saw him he had had a love affair which turned out unfortunately. To this was added a temporary pecuniary difficulty, but which of itself was far too small a matter to have caused worry in a healthy mind. In his case, however, it was quite sufficient to cause wakefulness, morbid aversion to mental labor, and extreme irritability. When I saw him, the expression of his face was emaciated and melancholy.

There was no facial flushing, but he informed me that, when even slightly excited, his face became alternately flushed and pale. The slightest reference to his condition was sufficient to provoke weeping and hysterical laughter.

Case III.—A gentleman of rather full habit, aged fifty-three years, residing in a rather malarious portion of the northern part of the State of New York, came under my observation about four months ago. His history in brief was this: Five or six years previous to consulting me he had had a severe attack of "malaria," for which he had been treated with large doses of quinine. Under this treatment his condition was so far improved that he abandoned the treatment, believing that a permanent cure had been obtained. For a long time afterward there was no further recurrence of the morbid symptoms; but about a year and a half after the first attack he became subject to frequent pains in the head. Sometimes these pains were situated over one hemisphere and sometimes over another. Sometimes they were located in the posterior portion of the head directly over the cerebellum. As a rule, however, they were confined to the forehead. During the persistence of these pains there was often flushing, and a considerable degree of irritability. Even the most trivial circumstance was sufficient to cause violent palpitations and outbursts of uncontrollable anger. These attacks of anger were almost invariably succeeded by severe weeping. Sometimes, however, he would laugh and cry alternately without the slightest assignable cause.

What has been said with regard to the treatment of the hypochondriacal symptoms which sometimes accompany the primary condition of exhaustion applies with equal force to this class of cases. I will therefore simply refer to what has already been said on the subject, thus avoiding needless repetition.

VIII.

PATHOLOGY AND DIAGNOSIS.

From what has been said in the preliminary chapters of this monograph, as well as on subsequent occasions, it is not difficult to judge of the general opinions entertained by the author with respect to the pathology of the subject.

Those opinions are briefly embodied in the term *defective nutrition*—a conception, by the way, which has been applied indiscriminately to every conceivable form of functional nervous derangement, being a convenient form of description for things of which little is known. As used in connection with cerebral exhaustion, however, it is peculiarly applicable. What is understood by the term, as here employed, is the inability of the cell to generate the normal amount of that force which is the physio-dynamical expression of the specific intra-cellular metamorphosis. The prominent pathological feature of brain exhaustion, as proven by the symptomatic manifestations, is a *quantitative* inadequacy of ganglionic function, consequent upon morbid inaptitude of the brain-cell to appropriate sufficient nutritive material from the blood-stream to neutralize the intra-cellular waste.

As a result of this condition we have a chronic predominance of cerebral waste over repair.

That the primary pathological condition is not one of cerebral anæmia, consequent upon general anæmia or local derangements of innervation, is proven by the fact that brain exhaustion is frequently found among those of full habit as well as in such persons as manifest no appreciable tendency either toward cerebral plethora or anæmia.

It may readily be conceived, nevertheless, that conditions of general debility may predispose to the occurrence of brain exhaustion, as well as to disorders of various kinds in other organs. To admit this, however, is a very different thing from assigning the proximate cause of cerebral exhaustion to general or local anæmia. If local or general anæmia were the proximate causes of cerebral exhaustion, then we should anticipate a spontaneous origin of the disorder *without* the intervention of exciting causes from without. Now, the real facts are that brain exhaustion is excited, above all things, by worry and excessive intellectual exertion—factors which affect directly the internal economy of the cell itself.

Mere anomalies of the cerebral circulation never produce the characteristic *quantitative* insufficiency of cerebral exhaustion. I have produced artificial cerebral anæmia, and hyperæmia as well, by purely mechanical methods, but have never succeeded in inducing the peculiar functional inadequacy found in cerebral exhaustion. The circulatory anomalies of cerebral exhaustion, where such exist, are, indeed, merely secondary mani-

festations of the primary intra-cellular trouble, induced, in the first instance, by illegitimate demands upon the available functional capacity of the cell itself. The two principal causes of such illegitimate demands are, as we have seen, extreme mental activity and inordinate worry.

When, however, the circulatory derangements have once become established, they in their turn serve to aggravate the condition of defective nutrition already pre-existent in the cell. These vascular derangements should therefore occupy a prominent place in any rational system of therapeutics.

In order, however, to remove the circulatory disturbances we must begin with the cell—we must address our therapeutic endeavors directly to the brain itself, and seek, by means of rest, nutrition, and specific tonic treatment, to restore the protoplasm to its former condition of functional competency. When we have succeeded in accomplishing this, it will be found that those abnormal circulatory conditions which were merely the outgrowth of defective intra-cellular nutrition have corrected themselves.

The above facts are perfectly comprehensible when we recall the manner in which the cerebral circulation and the ganglionic protoplasm act and react upon each other under physiological circumstances. Any morbid condition affecting the one must of necessity react upon the other.

While engaged in treating the anomalies of cell-nutrition, there is, however, no reason why efforts should not be made to *directly* modify those circulatory anomalies

which have already become established, and which must of necessity react in a prejudicial manner upon the deranged economy of the cell. But of this more hereafter.

Where there is a morbid augmentation of the amount of blood in the brain in cases of cerebral exhaustion, there is also, in all probability, a compensatory narrowing of the perivascular sheath, and an eventual outflow of lymph into the subarachnoid spaces.

Golgi,* indeed, has demonstrated anatomically that the lymphatic vessels are compressed and the current of lymph accelerated in cerebral hyperæmia. Moreover, the same author has shown, by the injection of Prussian blue, that there is a connection between the perivascular spaces and the lymphatics of the pia mater, and a communication between the latter and the subarachnoid spaces.†

In cases of cerebral anæmia the process is doubtless reversed, the vessels being in a state of contraction, whereas the perivascular spaces exhibit a corresponding dilatation. This, in brief, is about all that can be said respecting the pathology of the subject. But, inadequate as these statistics may appear at first sight, they form the substantial basis for a system of treatment which experience has shown to be most effective.

The terms hyperæmia and anæmia, in so far as they have been employed in this connection, are used to designate the secondary circulatory phenomena which are often so prominent a feature in cerebral exhaustion. I do not,

* "Riv. Clin.," ix, 1870, cited by Rosenthal in his "Clinical Treatise on Diseases of the Nervous System," p. 33.

† *Op. et loc. cit.*

however, wish to be understood as denying the possibility of the existence of a hyperæmia or anæmia of the brain independently of any previous exhaustion of the psychical or motor centers. To do so, indeed, would be to ignore the testimony of those whose authority on this point is not to be lightly refuted.

The consideration of those "primary" morbid circulatory conditions has, however, nothing to do with the present discussion.

Diagnosis.

The manifestations of cerebral exhaustion are so characteristic that it is difficult, under ordinary circumstances, to conceive of the disorder being confounded with other forms of brain disease. In spite, however, of the completeness of the symptomatic picture, mistakes in diagnosis may sometimes occur.

Such errors are best avoided by attention, first, to the history of the case and the mode of life of the subject previous to the attack; and, secondly, by resort to the method of exclusion, by which it is sought to determine what the case can not be.

With general paralysis of the insane it is usually impossible to confound it, on account of the absence of the characteristic delusions of grandeur and the physical symptoms, which constitute so typical a picture of this form of mental derangement.

From the first stages of primary dementia, particularly where the progress of the latter disorder is comparatively rapid, it may be difficult to differentiate some cases of cerebral exhaustion. Due attention to the minute

details of the case will, however, go far toward overcoming any obscurity or doubt liable to arise from this source. Moreover, cerebral exhaustion is far more frequent than primary dementia, which, in comparison with other mental disorders, is a rare affection. As soon as the dementia has become somewhat developed, there can, of course, no longer exist the slightest ground for doubt as to correct diagnosis, for the slothful, negligent, and filthy habits which are so characteristic of the dement constitute sufficiently striking phenomena for all purposes of differentiation.

Although there is marked impairment of volition in many instances of cerebral exhaustion, this morbid decrease in will-power is accompanied by so many other mental symptoms that it is impossible to confound such cases with those described by Hammond * under the designation "Aboulomania" (Paralysis of the Will), or by Legrand du Saulle under the name of "*Folie de Doute.*"

As already intimated, there can, according to my way of thinking, be no case of true cerebral exhaustion without a quantitative modification of the ratiocinative faculties—without a reduction in the *amount* of the individual's general intellectual capacity. Moreover, cerebral exhaustion is a malady with characteristic physical symptoms, pointing with absolute certainty to the existence of profound functional disturbances of the brain, located, without doubt, in the psychical area of the cortex.

Now, in the cases of *folie de doute* of which I have

* "Treatise on Insanity," by William A. Hammond, M. D. New York, 1883.

had occasion to observe some instances, I have never been able either to ascertain by inspection or interrogation anything confirmatory of the presence of physical symptoms pointing to grave functional brain trouble. The same may be said, to a certain degree, of the host of "morbid fears" which, taken by themselves and independent of the co-existence of other important mental phenomena, do not by any means serve to establish the diagnosis of brain exhaustion.

But it is perfectly clear that impairment of the will (or *folie de doute*), morbid fears, "hysterical" manifestations, and melancholia may, and indeed often do, accompany the more chronic forms of cerebral exhaustion, without, albeit, constituting the essential feature of the disorder.

Cerebral exhaustion is not liable to be confounded with cerebral softening, though, on a superficial glance at the symptomatology of the two disorders, particularly during the early stages, some points of resemblance will be found to exist.

Softening of the brain is, however, usually preceded by thrombosis, embolism, or hæmorrhage, and by the symptoms to which these conditions give rise.

Where cerebral softening comes on without any evidences of a pre-existent hæmorrhage, thrombus, or embolus, its advent is very gradual. The symptoms of mental impairment come on progressively as well as the paresis.

Moreover, cerebral exhaustion may occur at any period of life, being found among the young quite as fre-

quently as among those of more advanced age. Cerebral softening, on the contrary, though sometimes found among the young, shows a marked predilection to occur in the aged.

The history of the intellectual habits of the patient previous to the onset of the disorder will afford, in many instances, conclusive data upon which to base the diagnosis.

Without continuing this discussion further, which would only entail needless repetition, one word concerning a subject of subordinate, though by no means insignificant, importance in connection with the clinical examination of cases of functional brain trouble.

The Individuality of the Carotid Pulse.—It is astonishing that, in spite of the well-established fact that great topographical variations in the distribution of the blood is one of the most characteristic features of functional brain disorders, so little heed should have been paid to those arteries which constitute the channels by which the greater amount of blood gains access to the encephalon.

And yet the carotids are capable of affording information of no little clinical value in many cases of cerebral trouble.

This is particularly true of brain exhaustion, where, as already noted, the condition of the circulation is sometimes one of pronounced hyperæmia, whereas at others marked local anæmia is present.

Where the degree of congestion is considerable, the throbbing of the carotids is not only easily perceived

by the aid of the sense of touch, but, if the patient be asked to throw his head backward, so as to protrude the cervical vertebræ (and the artery as well) in an anterior direction, the morbid pulsation becomes visible to the eye. In cases of cerebral anæmia, on the contrary, the artery is found to have lost that quality of fullness which is so characteristic of congestion, and the sensation on digital exploration is one of unmistakable flaccidity.

Where the carotid pulsation is strong, the radial pulse will usually be found to exhibit a proportional feebleness, and *vice versa*. Hence the great difference between the temperature of the head and that of the periphery, which is so characteristic a feature of functional brain troubles.

Sometimes the head is cooler than the periphery; at others the converse condition prevails. Sometimes both states are found to alternate in the same patient every twenty-four hours or oftener.

I have remarked in this latter class of cases that the temperature of the head is frequently higher at night than in the early morning hours. Where this is the case the subject almost invariably complains of cold feet on retiring.

Comparative determinations of temperature should be made in all such cases, with an eye to ascertaining the time at which the morbid circulatory manifestations occur, in order that appropriate therapeutic measures may be undertaken for their removal.

These thermic measurements are best conducted with

Dr. Lombard's Thermo-Electric Differential Calorimeter.* In employing this instrument for the purpose specified, one thermo-electric pile should be placed upon the head and the other upon the palm of the hand or the sole of the foot. The amount of deviation obtained from time to time should be carefully recorded, as well as the time at which the observation was made.

As previously noted, these circulatory anomalies are merely one of the results of the primary derangement resident in the cell itself. But both experiment and pathology having proven that such vascular derangements react in a prejudicial manner upon the cortical area of the brain, their diagnostic determination and treatment are matters of importance.

Finally, the method of exclusion should be applied with rigor before forming a final opinion in cases of functional brain trouble. Having formed definite conceptions with regard to what the disorder may be, we should endeavor to prove what it can not be. If the two methods agree, then the certainty that a correct diagnosis has been made may be reasonably entertained.

* This instrument has been described so often of late that I shall omit a detailed account of it on the present occasion. A description of it will be found in Hammond's "Treatise on Diseases of the Nervous System" (seventh edition).

CAUSATION.

IX.

PREDISPOSING CAUSES OF BRAIN EXHAUSTION.

THE causes of cerebral exhaustion may be divided into two groups: those arising out of the peculiar relations of the individual to the material exigencies of life and to society, and those arising from sources inherent in the individual himself. Under the former head are included the indirect sources of brain exhaustion, while the second group comprises more particularly the exciting causes of the disorder.

Let us bestow a glance upon some of those forces inherent in animate and inanimate nature—in society and in things—which may of themselves result in an overtaxation and eventual permanent impairment of the thinking apparatus. First, as to man's conquest over matter. At a very early period of unwritten history the wants of human beings were few and simple, and each individual represented in a certain sense an epitome of the natural science of the times. To pick an apple off a tree, to crawl into a cave at night to escape the attacks of wild beasts, and to fashion a primitive garment from the fibers of trees or the skins of animals, were comparatively simple matters. In those days there were no aristocrats

of the pen, and the sages of the laboratory were yet unborn. Indeed, it may truly be said that among such a community knowledge was equally diffused—there could be no scientific monopoly—there could be no protection of ideas, for there were practically no mental commodities to levy taxes upon. Since those early days, however, we have made progress, or, at all events, we have grown more complicated. Men are no longer the homogeneous creatures they once were. The dissonance in society incident to dissimilar occupations and to the struggle for existence has not only alienated interests, but has also produced such a wide difference in modes of living that each class of workers may be said to have attained certain specific peculiarities of its own. Among those qualities may be reckoned tendencies to specific forms of disease, resulting from morbid methods of action. According, moreover, as to whether that same activity is mental or physical will be the nature of the disorder. Inversely if we have, for example, certain symptoms pointing to impairment of the functional efficacy of the motor apparatus, we shall frequently find that the disorder is primarily traceable to some abuse—some overstrain of the muscular system itself. The same may also be said of mental phenomena. If, by way of illustration, there is present a set of symptoms pointing to insufficiency of intellection, we are not only justified, but required, by due regard to the scientific exigencies of the case, to inquire, with the utmost diligence, into the mental habits of the patient; and we shall find, in a large number of instances, the origin of the disorder in some perversion of brain-function itself. It

would seem, on a superficial examination, that the causes which we have been discussing were not what may strictly be called predisposing or indirect—are not directly chargeable to the account of extraneous circumstances. Indeed, this is in a measure true. Morbid methods of intellection are something over which the individual himself has in a measure control. But in the vast majority of cases we find that there is an *indirect* causative factor lying behind the individual action, namely, extraneous pressure in some social or material shape; and it is to this causative element that I would draw attention. The night-clerk has indeed control over his own actions, and might cease his pernicious methods of work to-morrow, but there is the question of an honorable livelihood. The staff and employés of a great daily journal might cease their arduous duties during the hours of darkness and resign themselves to that night-rest which is, under all circumstances, more healthy than day-sleep, but we should receive the news of the world after it had ceased to be news, as we understand that term to day. Again, even a temporary suspension of journalistic activity would be tantamount to a regressive step in civilization, for journalism at the present day means not only the presentation, in the best and most concise manner, of the latest events in the world's history, but it also implies leadership in political and social events. Besides the examples above cited as illustrations of the *vis-à-tergo* governing human actions, there are many others peculiar to certain civilizations as a whole. Thus there are political and social conditions governing the relations of the intel-

lectual classes of this continent which particularly predispose to mental overstrain. The republican form of government so firmly established on this side of the Atlantic has given rise, both directly and indirectly, to overstrain of the nervous centers. One has but to call to mind the extraordinary excitement and tension prevalent during primary meetings and elections to make this point clear. Indirectly, the political institutions of this country are well calculated to promote mental exhaustion, on account of the great inducements which they hold out to each and every member of the community, be he ever so humble. The fact that we have no privileged class, protected by law, in this country, lends a morbid impetuosity to the efforts of both the poor and moderately rich members of the community; for it is well understood that if one can but acquire the usages of good society, abstain from too prominent a display of vulgarism, and pay the quarterly bills, be they ever so ponderous, there is nothing to bar the entrance to circles of the greatest social potency. On the other hand, when social eminence has once been attained, the obligations of the position are so great that a concomitant output of mental energy becomes a necessity, and, as the demand in very many instances exceeds the available supply, exhaustion of brain energy is the inevitable result. The foregoing is by no means true to the same degree of European civilization, for this reason: that in Europe hereditary wealth is far more common than with us; consequently there is a proportionate decrease of the active obligations of the individual.

A very great factor in the production of brain exhaustion is the incredible subdivision of labor. This subdivision is not confined to manual labor, but, on the contrary, has crept into every department of mental activity, until at the present day it is quite impossible to predict where the tendency will eventually cease. The result of this mental particularization has been to foster a condition of prolonged concentration of isolated faculties of the mind; and, as we know, this is one of the best methods of promoting mental insufficiency. These facts are, however, less applicable to higher specialization, for, in the majority of instances, those in the learned professions who confine their attentions to certain specific departments are in so far independent that they can, and indeed in the majority of instances do, seek diversion by general intellectual pursuits.

To my mind one of the most important factors in the production of a predisposition to functional nervous disorders in this country is found in certain climatic peculiarities. Proof of this is found in the fact that foreigners, and the children of foreigners, who have made this country their home and yet adhere with pertinacity to the customs of the countries whence they came, are, nevertheless, prone to become victims of brain exhaustion and other functional troubles. I have also frequently met foreigners who complain that mental exertion is very much more difficult here than abroad —that they can accomplish far less brain-work in a given length of time here than in their old homes, and that they are unable to continue prolonged mental work

without frequent interruptions. There is very little doubt in my own mind that the intensity of animal life is indeed greater in this country than abroad—that, in a word, waste is more rapid, and that to keep repair on a par with waste — to keep up the proper correlation between disintegration and integration—is not only a problem of therapeutics, but also of normal every-day existence. Another interesting feature in connection with functional nervous disorders is their extreme liability to be transmitted by inheritance; or, to speak more correctly, the diathesis which predisposes to their occurrence is very subject to the laws of heredity. Moreover, the foregoing applies, strange to say, with equal force to the descendants of foreigners, and I can confirm by my own experience the assertion of the late Dr. G. M. Beard, that some of the most exquisite cases of functional nervous trouble occur among this class of individuals.

It is noteworthy as regards the special climatic peculiarities of this country which predispose to the occurrence of functional nervous disease, that they appear to be intimately associated with a peculiar atmospheric dryness—with great and sudden changes of temperature, and with diminished atmospheric pressure.

In no country do we find climatic conditions so eminently calculated to overtax the powers of thermic accommodation possessed by the organism as in the United States. This is particularly true of the territorial districts and the States of the Northwest. Moreover, statistics from residents, physicians, and others who have

visited in the higher sections of the Western States, all agree that there is a far greater prevalence of functional nervous disease in those elevated regions than upon the Atlantic seaboard. The vital manifestations of the inhabitants is in perfect consonance with these statements; they are energetic, impulsive, and enterprising to a degree which is well calculated to excite wonder even among Americans. Sooner or later, however, there is a reckoning with the relentless laws which govern the forces of the vital economy, and the debt is paid in the form of some derangement of nervous function. In nine cases out of ten this disorder assumes the form of an impairment of brain energy, with or without hypochondriacal accompaniments.

X.

FALSE EDUCATIONAL CONCEPTIONS AND METHODS.

It has been correctly noted by no less an exquisite than Addison that men must be on their guard lest they allow themselves to be polished out of their individualities. Likewise, had he lived at the present day, he might have said the community should see to it that their youth are not educated out of their wits, and that the men of the future are not transformed into repositories of pedantry. Things have gotten to a pass, in fact, where, the mind being merely considered as a hopper, nothing further is deemed necessary to the promotion of its function than that the pedagogue shall fill in the grist to the margin. It would be an interesting question to ascertain just how much corn is contained in the heterogeneous mass of chaff! Is it surprising that often under the force of abnormal exaction there is friction, that the millstones of the mind turn slower, that there is a halt, or even utter darkness? But, it may be asked, How is this state of affairs to be remedied; how is the spirit of the times to be resisted; are we not to satisfy the increasing demands of modern life, and is not our educational system just as much an integral part of the machinery of modern life as the railway

or the telephone? The reply to this is comparatively simple. A thirst for education and an active and imperative demand for it are indeed characteristic of this century, and particularly of this country. But to admit this proposition is one thing, and to affirm the adequacy of the clumsy *system* which purports to fulfill the higher educational demands of the times is another. Any system of gymnastics, to fulfill the physiological indications, must take cognizance of the degree of muscular development.

We should think it a very unscientific procedure indeed if it were demanded of a child that he fulfill certain tasks in gymnastics corresponding in intricacy and extent to those fitted only to the *developed* muscular system of adult life. And yet this is precisely what we have been and are still demanding of the undeveloped brain—an organ, by the way, as much more intricate and delicate than muscle as the ocean is broader and deeper than an inland lake. To be brief, then, the system of education as we find it in most civilized countries at the present day is not a system at all in the *physiological* sense, however admirable it may appear from the standpoint of simple *a priori* reasoning. It has but very recently taken cognizance of individual endowment in this country, in the form of the "elective system," and has never followed the course indicated by inevitable deductions from the truths of biology. In a word, the system has occupied itself to but a limited extent with the ultimate demands of society upon the individual, and has taken little account of the physio-

logical exigencies of the individual living being as such. Did ever a board of instructors engaged upon the codification of a curriculum so far emancipate itself from the tread-mill of tradition as to inquire in how far their efforts were in correspondence with the fundamental laws of psychology and cerebral development; or in how far they were acting in accord with the requisites of mental physiology? We fear not.

What can be more absurd than that view of education which compels children at an early age to give their unripe energies to the frightful drudgery of learning by rote a few wretched bits of Greek and Latin? And then the method itself! can anything more abnormal or abominable be conceived of? Yet, in the face of the fact that not only is there no practical discipline in these preposterous methods of assimilation, but positive harm through the dread of learning thereby inspired, as well as by reason of the inevitable annihilation of all imaginative power, there are still those who persist in declaring that no curriculum should be tolerated in which the abnormal method of acquiring classical languages, still so largely prevalent, is not a *sine qua non*. Nor do these strictures apply alone to the systems of education prevalent in this country and England. On the contrary, the scholastic training which precedes the entrance of German youth into the university is tainted to a surprising extent by the same element of pedantry. But in the university, fortunately, a different state of things prevails, and, under the favorable influence of "academic freedom," he not infrequently recovers from

his temporary mental sclerosis. Sometimes, however, he carries a load of ill health and pedantry to his grave as the direct result of defective early training and dissipation. One effect of the "cramming" system, just referred to, is the total abolition of all individuality; there are few types among German school-boys, pronounced individualism being conspicuous by its absence.

As above noted, however, the universities, which are a far more enduring source of glory to Germany than her present policy of armed repression, tend by their elective system of study to neutralize in a measure the pedantry sown in the preparatory schools. The great defect of the system of preliminary education consists in this: that it fails to recognize the fact that the human understanding is capable of development in the direction of originality at an early age; and that individualism can and should be developed to a very considerable degree before the age of one-and-twenty. This overburdening of the mind without regard to the laws of evolution is also well exemplified in our own country by the perfectly incredible number of branches of learning which constitutes the mental *menu* of the average child of fourteen or fifteen years, and which is expected to be absorbed, *but not digested.* That this system of "cramming" is one of the most prolific predisposing causes of brain exhaustion is shown by the fact that many children, who in early years had been frequently obliged to discontinue school on account of morbid brain fatigue caused by overwork, have, later on in life, become the victims of more or less chronic cerebral exhaustion.

As regards our present system of college education, many and essential reforms are urgently required. This is more particularly true of the under-graduate course, the expediency of whose existence has more than once been questioned by practical men. As a result of the fact that large numbers of young men of talent who, desirous of pursuing certain branches of scientific research, have been obliged to abandon the institutions of their own country in order to avail themselves of the cheaper and far better facilities afforded by German universities, there has been inaugurated a considerable spirit of reform in this direction. Even the authorities, who for centuries have perpetuated in England the semi-monastic methods of the middle ages, have at last become aroused to the fact that, whatever may be their own preconceptions, society, at least, has come to believe that there are other languages besides Greek and Latin, and that there are other sciences of disciplinary efficacy besides mathematics. As a result of all this, we may ere long expect to see the "quiz-master" dethroned, and in the place of traditional lore we shall have anatomical, physiological, pathological, chemical, and other institutions, where science shall be *advanced* as well as taught by methods of themselves calculated to excite the utmost enthusiasm. Then there will be no necessity of sending the youth of the country abroad in order to perfect themselves in any particular branch of science; there will also be a great decline in the number of those permanently reduced to a state of chronic mental imcompetency by unphysiological methods of instruction. To

be proficient in a science will then be considered to be not so much a matter of being stuffed, like a goose or a game-cock, as being in harmony with the principles and spirit of a particular branch of knowledge. The large numbers of both young men and women who year by year suffer more or less protracted mental injury, or are permanently incapacitated by chronic brain exhaustion from fulfilling any function in life involving even a moderate expenditure of brain-force, has at last thoroughly aroused parents and guardians to a realization of the magnitude of the danger which threatens the mental interests of the next generation of Americans. The following article, which appeared in the editorial columns of the "New York Tribune" of June 17, 1883, and which, on account of its lucid exposition of the subject, I herewith quote in full, will afford some idea of the impending revolution in educational matters; and will at the same time give an accurate idea of those evils of the present educational system which so imperatively demand reform:

"In the college commencements which filled up last week, one or two subjects were brought prominently forward of importance not only to the young people and their families, but to the country at large; for we must remember that the condition of the country twenty years hence will largely depend upon this very education which we are now giving to these boys and girls.

"One of these suggestive points of interest was offered by the complaint of the family of Johns Hopkins that the great university endowed by their relative is not doing

the work which he intended—of educating the masses of poor young men. 'The education,' they say, 'given is the highest—it is too high. It seems to educate further already well-educated post-graduates of other colleges. With forty-one professors and an income of $225,000, we should be educating a thousand young men instead of two hundred.' Precisely the same complaint might be made of one or two other important institutions richly endowed by large bequests for the express purpose of educating young men of limited means. The course of study necessary to obtain a diploma in some of these is so difficult as to be simply impossible to a boy of ordinary intellect; hence out of freshmen classes of seventy, four or five boys worry through, often with broken health and exhausted energy. Now, if the object of the men who endowed these colleges was to send out yearly a few highly educated scholars, this system is the proper one; but if it was to afford a chance to the mass of young men for development and usefulness, this system completely thwarts and makes it null.

"The earnest protest of the Vassar graduates against the plan pursued in that college bears upon a similar part of our modern educational training. The protest was moderate and strong in both meaning and language, and deserves careful attention from every parent. The author (who had herself won the first place in the graduating class, and was therefore entitled to speak) urged that the system of placing 'Honors' at graduation before the pupil at her entrance into school, as the chief object of her endeavors, 'induced a nervous strain in-

compatible with her highest physical or mental development. The system was not a correct index to either ability or industry; it led to superficial work, done mainly with a view to gain high marks, and the motives for study induced by it are unworthy ones.' It is not Vassar College alone to which this protest is applicable; it might be urged in almost every public and private school in the country. There is hardly a thoughtful parent who does not know that the object set before his boy and girl at school is, not the gradual healthy development of their mental power and ability for usefulness, but a certain number of marks, a high place in their class, some paltry distinction on graduating day. Pupils thus fail to perceive how utterly factitious and worthless these successes are a week after they will leave the school. The argument of the teacher is that the examination-marks are a test of the pupil's proficiency. This is seldom correct. They are a test of his verbal memory and physical endurance. So wide is the range of study required now even in primary schools that nothing more can be done by the pupil than to commit the text-books to memory; to learn as it were the alphabet, the dictionary, of each science, in the vain hope that in after life he may learn to comprehend it, to speak the language. Without entering upon the vexed question of the higher education for women, we may illustrate our meaning by the schedule of studies offered the other day to women in Columbia College. The range of study in each branch consisted of bald text-books, compendiums, and grammars. What thoughtful woman, for example,

in a good library with one year's quiet reading, would not absorb an infinitely wider and truer knowledge of either history, language, or literature than was included in this school curriculum for four years? It is the letter that kills in our whole present school system; the spirit is needed to make alive.

"It is easy to understand how the mistake has been made. Naturally each college has an ambition to raise its standard. Each professor, for his own reputation's sake, seeks to 'bring up' his branch of study. Whether the boy has physical strength or mental capacity to bear the strain put upon him is not considered. If not, let him go out. The standard of work required is set by the capacity of the abnormally gifted or toughest student. Now, the fact is that the mass of pupils in any school are not particularly clever nor physically strong. But they, too, have their place to fill in the world; and, if they work faithfully at school to fit themselves to fill it, it is unjust and cruel to turn them out into it at the beginning of their career with a sense of defeat because Nature did not endow them as highly as a few of their brethren. The 'Tribune,' has called the attention of colleges and teachers to this increasing and fatal error. It only echoes the opinion of parents everywhere. They see, if teachers do not, that the real object of education in American colleges should be not to elevate the reputation of this or that college or faculty, nor to train a few exceptional intellects among pupils, nor even for a time to foster high scholarship, but to develop the capabilities of every grade of students, to encourage, not stamp

upon, the dull, stimulate the idle, fit even the most stupid for the humble place that he will hold. The faculty and college that soonest recognize this fact and act upon it will not only command the gratitude of parents, but will do the best and most effective work for the country. It is not cloisters or shades of lettered ease like Oxford and Cambridge that the masses of the United States want for the next fifty years so much as schools like Rugby."

From the foregoing article, as well as from the attitude of the enlightened press at large, it is perfectly evident that, whatever may be the delusions of pedantic pedagogues on the subject, the public at large is not misinformed. What is demanded is physiological education—an education in consonance with the laws of cerebral development in general, and in harmony with individual endowment in particular. If there ever was a time in the history of the world when the energies should be so taught as to fit the individual for the battle of existence, it is now. Education must therefore be, furthermore, of a kind which shall place the subject in harmony with his environment; in other words, it must be practical, and to that end must contain, as a rule, only so much theory as shall be necessary to an enlightened practice. This applies to business and professional pursuits alike. The functions of great educational mechanisms is not to take cognizance of the wants of the few, but of the many. Universities should not, as a rule, be harbingers of intellectual exotics; but rather from out their portals should go a savor of a kind to season the

mentality of a whole nation. It is equally important, however, that the preliminary course of training for such institutions should be adequate, but at the same time of such a kind that the mind does not find itself, on the threshold of college life, in a condition of semi-mummification.

The foregoing discussion of the principles of education was entered upon from purely scientific motives, and not from any especial desire to attack existing institutions, except in so far as the latter are conducted in a manner palpably at variance with the fundamental laws of biology and common sense. Unphilosophical methods of mental training, constituting, as they do, a prolific source of brain exhaustion and insanity, I have been obliged, from the nature of the task set before me, to discuss. What, judged by scientific standards, are grave faults in the systems of education at present in vogue, I have handled without gloves; but at the same time I have not descended in any sort to anything which, by even the most vivid imagination, might be classed as offensive or personal.

Having said this much, I can not refrain, in concluding this chapter, from paying a tribute of sincere respect to those centers of American academic thought, Harvard College, Johns Hopkins University, and Cornell University, which, in the face of manifold opposition, have inaugurated reforms of a nature well calculated to make the hearts of the well-wishers of humanity glad. There is little doubt, from present indications, that the reforms, so nobly begun, are destined to proceed with that vigor

which is so characteristic of all great enterprises and popular movements in this country; and that ere long barbaric and mediæval methods of education will have been consigned for evermore to well-deserved oblivion. In this noble reform the daily and periodical press have borne an important and highly honorable part, whereas professional educators, when not actively engaged in opposition to all progress, have but too often lingered far in the rear of an enlightened public opinion. Exceptions to this rule, however, have not been wanting, and the attitude assumed by certain gentlemen of prominence in educational matters reflects enduring luster upon their signal powers of judgment as well as upon their courage and honesty of purpose.

XI.

EXCITING CAUSES OF BRAIN EXHAUSTION.

In the preceding chapter we have discussed those conditions which predispose to the development of cerebral exhaustion. It now remains to consider briefly certain factors dependent more or less for their existence upon the individual himself, and which are at the same time to be reckoned among the adjacent sources of wakefulness. And here it may be as well to state that the classification of causation which I have adopted is undertaken purely as a matter of convenience; it is perfectly clear that an absolute discrimination between causes traceable to external sources and those to be reckoned to the account of the individual himself is as impossible a task as would be the attempt to ferret out the sources of all human action. Still, some sort of a classification is demanded, and this one seemed to me to meet the practical demands of the case as well as any.

Among the most fruitful exciting causes of brain exhaustion are those which, in combination with overmental work, exercise a direct strain upon the emotional apparatus. They are among those causes, also, which, above all others, produce the most pernicious

effects upon the function of sleep. In this category belong heavy responsibility, suspense, great and sudden pecuniary losses, jealousy, profound grief, and, in a word, the whole list of ills which result in the production of the most acute form of worry. The following case, taken from my note-book, is an illustration in point:

L. K., a merchant of high respectability and wealth, consulted me some time since with regard to a trouble which he himself believed to be softening of the brain. Close questioning revealed the fact that, some months previous to calling upon me, he had suffered severe pecuniary losses growing out of certain transactions of a speculative character, which, while not involving in any manner his character or honor, he believed for some time were destined to cause his financial ruin. At the time I saw him his affairs were so far righted that there was not only no immediate danger of disaster, but, on the contrary, every prospect of a speedy restoration to a comparative condition of prosperity. Nevertheless, his symptoms were such as to induce the belief that he was suffering from softening of the brain—a common delusion, by the by. For many weeks he had suffered from severe sleeplessness, owing to incessant worry and apprehensions respecting the possibility of loss of social status. The physical and mental condition resulting from the insomnia, already bad enough, was enhanced by a desperate effort to right his affairs, involving far more than the usual amount of mental work. After continuing in this condition for several weeks, the following symptoms were gradually de-

veloped: Severe pain in right upper parietal region, increased by reading or writing. Very profound attacks of depression, which patient sought to relieve by resort to copious stimulation. Facial flushing and palpitations of the heart, particularly after meals, with subsequent paleness and vertigo. Patient very irritable; a trivial pleasantry is sufficient to arouse a fit of violent anger. Society of wife, children, and friends distasteful. Appetite very poor. Bowels irregular, with tendency to constipation. Head cool during a great portion of the night, but sometimes hot. Sleeps very little, and at such times is troubled by dreams; denies hallucinations. Has been obliged to discontinue all extra mental work, and even short periods of routine work at office cause severe pain in head and great subsequent prostration. When, some time later, this gentleman came under my observation, he was totally unable to perform any mental work whatsoever. He had already been treated by one practitioner for "nervousness," and his back was marked by recent traces of the actual cautery. Sleep was profoundly deranged. The digestive functions were unimpaired, and there was no trace of organic disease nor syphilis. All tobacco influences were manifestly excluded, as patient had never smoked more than two cigars a day, and of late had abandoned the habit entirely. I forbade the further employment of brandy and whisky; substituted instead the fluid extract of coca with Burgundy; prescribed beef-tea four times a day with raw egg; and proceeded at once, by the moderate use of the bromides during the day and by a cautious appli-

cation of sedatives at night, to combat the morbid wakefulness.* In four weeks patient had gained, according to his own statement, ten pounds, and, although all mental work was interdicted, declared that he believed he could "do some work once more." After the lapse of the second month, I found that the average amount of sleep obtained during the twenty-four hours (reckoning day-sleep as well) was for the past three weeks between thirteen and fourteen hours. The personal appearance of the patient had undergone a complete transformation. The expression of the eyes was most striking and instructive; the dead and "bottomless" look had given place to an aspect which, if not actually that of vivacity, was so totally different from the former morbid appearance that it excited the comment of his family and friends. Improvement in the function of sleep had caused a corresponding benefit to be felt not only in the mental economy, but in all the tissues as well. There was a considerable increase in weight already apparent, as we have seen, after the first four weeks of treatment, and also well-marked improvement in the muscular system. But it was in the mental economy that most improvement was apparent; not only could brain-work be endured in moderate amounts each day, but it was actually desired—so much so, in fact, that frequent peremptory warnings were required to prevent a possible renewal of the attack. The head-pains had entirely disappeared, except when occasionally pro-

* *Vide* the views on the treatment of sleeplessness contained in my monograph on "Brain Rest," published by G. P. Putnam's Sons.

voked by some indiscretion in the matter of undue intellection.

The above case is instructive as showing very clearly what marvels may be produced by hyper-nutrition combined with prolonged brain-rest. I have not cited it, however, on account of any therapeutic conclusions which may thence be derived; but, on the contrary, because of the clearness with which it exhibits the baneful effects produced upon the brain by a combination of overwork and excessive worry. The injury produced upon the thought and emotional centers by a high degree of worry, conjoined with undue intellection, it is almost impossible to overestimate; indeed, a very large percentage of cases of brain exhaustion is directly traceable to this baneful combination of causes.

Among the other exciting causes of brain exhaustion may be mentioned excesses, particularly over-sexual indulgence. This, so far as the male sex is concerned, is a frequent source of morbid brain fatigue, the latter condition often terminating in chronic mental insufficiency where there are at the same time any considerable demands upon the mental faculties. Desultory methods of intellection are a not infrequent source of brain exhaustion. The habit of turning night into day, and carrying on literary pursuits till the small hours of the morning, is sure, sooner or later, to result in a derangement of the function of sleep—a condition favorable to the production of cerebral exhaustion. Another habit—which, by reason of its pernicious influence upon the rhythm of the intellectual processes, is especially deserving of attention

—is that of springing from one intellectual pursuit to another. It has become far too fashionable a habit at the present day for those who have been trained for a series of long years to a certain calling to abandon the same, upon the most trivial pretext, for some other occupation entirely at variance with their former mode of life and previous training. This is a wrong state of affairs; for, besides entailing an abnormal amount of extra intellectual work for the purpose of acquiring dexterity in the new profession or business, it also directly fosters a restless and discontented condition of mind—a state whereby friction and worry are allowed to assume their baneful sway. (*Vide* chapter on Predisposing Causes of Brain Exhaustion.)

While an inordinate or desultory use of the intellectual faculties is prejudicial to mental health, an insufficient employment of the mind is also fraught with no little danger. As society is at present organized, a certain output of mental energy is incumbent upon each and every member. The *tædium vitæ*—that disgust of life so frequently found among those who, by reason of the possession of hereditary wealth, are exempt from the necessity of mental employment—is symptomatic of an intellectual atrophy consequent upon disuse alone. Such individuals are commonly reckoned among the privileged classes, and yet, regarded from a physiological standpoint, they are of all men most miserable. Absolved from all necessity of occupying themselves, totally destitute of any stimulus to intellectual endeavor, such persons become but too readily the victims of vices, which they

resort to in utter desperation, as a fancied relief from intolerable *ennui*. Various forms of physical ailment usually ensue upon these excesses; and, having nothing else to think of but himself, the individual contracts the habit of an endless introspection. This habit of the subject, of continually regarding himself in the mirror of his own distorted understanding, gives rise to a variety of gloomy reflections, which usually culminate in the formation of a host of hypochondriacal symptoms. The mental faculties of these persons do not usually suffer from the inroads of exhaustion; there is, in fact, very little mentality to exhaust—their intellectual condition approximating very much that of the clam. Their condition, briefly expressed, is one of chronic intellectual corrosion. Such individuals are certainly subjects for pity and treatment as well. Their cure is, however, not a question of drugs or of rest, but of hard, uncompromising work.

Inordinate exercise of the emotions, worry, and intellectual excesses, are indeed prolific sources of premature mental decline. But, on the other hand, disuse of the mental faculties is a promoter of another form of intellectual insufficiency of no inconsiderable importance.

Having said thus much respecting the more prominent causes of brain exhaustion, it now remains to consider somewhat the effects exercised by tobacco and alcohol upon the mental faculties.

XII.

EFFECTS OF TOBACCO AND ALCOHOLIC EXCESSES ON THE BRAIN.

THERE is some difference of opinion among writers and statisticians as to whether insanity is actually increasing in this country or not. Owing to the difficulty of eliminating sources of error arising from immigration and other causes, exceptional caution should be exercised before accepting any opinion on the subject as absolutely final. Nevertheless, after everything has been said for and against both of these opposite opinions, one can not help feeling that there is very considerable reason for believing that mental derangements are, on the whole, increasing.

It is not my purpose to enter at length upon the discussions of this interesting and important question; that would be to exceed both the limits and objects of this memoir. What more nearly concerns us here is to examine somewhat into those conditions which of themselves are capable of producing a state of things within the domain of the cerebral economy favorable to the invasion of mental disease.

First in order are those forces which inhere in the

very nature of modern life. Poverty, Ignorance, Inebriety, and Vice are the names of those specters which first weaken and ultimately destroy the mind. There are two very essential particulars in which the physiological economies of a large portion of the modern world differ from those of primitive peoples. First of all, there has developed since the Spanish conquest an enormous consumption of tobacco. So universal has the habit become that there is scarcely a country of the world in which the habit is not already thoroughly grounded. Not only does the civilian of France, England, Spain, and Scandinavia indulge in his daily allowance of the fragrant weed, but even the armies of martial Germany march to the fray with the pipe dangling between the lips of the rank and file. The second and more important particular to be considered in connection with the individual habits of modern peoples, in counter-distinction to those of ancient and primitive nations, is the phenomenal consumption of alcohol in the form of distilled liquors. Whereas the wealthier classes among the ancients were addicted to the use of wines of various kinds, in moderation and not infrequently in excess, it has been reserved more particularly for modern races to exhibit in their civilizations the melancholy spectacle of both poor and rich submitting themselves to that most baneful form of serfdom—the alcohol habit.

The frequent bacchanalian feasts of the wealthy and educated classes of Greece and Rome were evils; but, in comparison with the quotidian alcoholic excesses

of modern peoples, they may well be regarded with extenuation. That the wealthy and privileged class of society should become debauched is not to be wondered at, for moral degradation is but one of the usual imposts paid by opulence; where, however, a morbid habit, affecting the near and remote interests of both mind and body, has penetrated so far that its victims are not confined to any one class, but are found in every stratum of society in ever-increasing numbers, until a national pollution is threatened, that indeed is a calamity. With regard to the degree of consumption of tobacco in the world at the present time, statistics differ somewhat. One thing is very certain, however, and that is the comparative universality of the tobacco habit. Thus, von Bibra, I believe, estimates the number of tobacco-consumers in the world at the present day at about eight hundred millions—an enormous number when it is borne in mind that the population of the entire globe is not much above one thousand millions. Now, what is the effect of this vast consumption upon such an enormous body of human beings? To answer this question properly we must consider, in the first place, what are the effects of moderate doses of tobacco upon the organism, and, in the second place, what are the effects of the drug when indulged in to excess?

First as to the effects of moderate doses upon the general system and nerve-centers.

When taken in *stimulating* (moderate) doses, tobacco increases weight by retarding metamorphosis—by diminishing tissue-waste. At the same time, by its action

upon the sympathetic system, it not infrequently proves a powerful aid to digestion, except, of course, in cases where there is some pre-existing disorder of the organs of assimilation.

In *mild narcotic* doses it has been of the utmost use to many brain-workers, but must not be indulged in during mental activity in order to obtain the best results; on the contrary it should be employed *after* the mechanism of thought has performed its function, *and it is desired to remove the condition of cerebral erethism* which may persist after the brain has concluded any protracted or arduous mental work.

When, however, tobacco is employed to *excess*, a variety of disagreeable symptoms may be produced, thus:

Tobacco Symptoms.—If tobacco be indulged in while the stomach is still empty, a disagreeable sensation of nausea is often produced, accompanied by headache, which may be diffused or circumscribed in character. The above symptoms are particularly liable to occur in weak individuals or in those of the so-called "nervous diathesis."

Sometimes after protracted smoking a sudden sensation of vertigo is experienced, accompanied in certain instances by a momentary loss of consciousness resembling the first stage of an epileptic seizure. At other times, if the individual be walking, a sudden dizziness comes on, accompanied by a sensation of falling forward, while a feeling as though the ground is slipping away or that the soles of the feet are "touching cotton wool" may induce the belief, perhaps, that the symp-

toms are those of the first stage of locomotor ataxia. If smoking be forbidden, the disagreeable symptoms disappear as soon as the nicotine has been eliminated from the system.

A very important effect of nicotine is its power of directly influencing the mechanism of intellection. Thus, in cases of excessive smoking, the ideas lack clearness of outline, and there is often difficulty of rapidly co-ordinating impressions. Again, the will is often very considerably affected, and a species of inertia takes possession of the voluntary faculties. Great difficulty is experienced in rising early; the performance of the routine duties of every-day life becomes burdensome, and by degrees a condition of chronic irritability is engendered, which often renders the sufferer liable to outbursts of uncontrollable passion. At such times I have remarked that the face is usually flushed; but sometimes it is pale.

Impairment of memory is another frequent accident, and one well calculated to cause no end of inconvenience.* Disorders of the vaso-motor mechanism are frequent, as witnessed by the alternating facial hyperæmias and anæmias to which those suffering from the tobacco habit are subject. These circulatory anomalies co-exist with vertical pain and vertigo, in the production of which they are doubtless partly responsible. The strong analogy existing between the symptoms sometimes caused by nicotine and those produced by brain exhaustion can not have escaped notice; and specula-

* "Study and Stimulants," by A. Arthur Reade. London, 1883.

tion as to what should have produced this similarity in the two symptomatic groups becomes unavoidable.

Tobacco, like other narcotics, is variable in its effects according to dose and individual idiosyncrasy; but its most obvious and constant effect is the production of a condition of lethargy of the ganglionic protoplasm—a kind of artificial exhaustion, in fact.

Thus, in brain exhaustion we have to do with a condition of the ganglia in which the processes of disintegration have outstripped those of integration—a condition in which the ganglia are no longer able to hoard up the usual and requisite amount of explosive energy. This state of things, as we have seen, was engendered by such physical factors as worry, jealousy, suspense, pecuniary loss, and over-mental taxation. The origin of the multifarious mental symptoms of tobacco, however, is traceable to a direct physiological interference, *on the part of the active principle of the drug*, with the internal economy of the brain-cell itself. That interference is equivalent to a retardation of nutrition; and in so far there is actually a resemblance between the proximate morbid principles underlying brain exhaustion and those which lie at the root of the tobacco symptoms. The physiological chemistry of the two conditions must, however, be totally different. I have been thus explicit concerning tobacco for this reason: that, without due heed being paid to its possible effects, great errors are liable to be, and indeed are, constantly made in diagnosis. Furthermore, a knowledge of the effects which the excessive abuse of tobacco is capable of exercising upon the cen-

tral nervous system will constitute the solid basis for the formation of logical deductions respecting the amount of harm which the drug may actually cause when introduced into the human system. Thus, it is sufficiently evident from the foregoing that the excessive use of tobacco creates an irritability and derangement of the brain economy which renders that organ far more susceptible to disagreeable extraneous impressions than under healthy conditions.

Furthermore, if the excretive powers of the organism be not equal to eliminating the large quantities of nicotine introduced into the system, the minute morbid changes in the brain may become chronic, and therefore the condition described above assume a permanent character.

We have, in a word, a condition approximating in many particulars what is known as the insane diathesis—that is to say, a state of things favorable to mental invasion. That the condition which we are here considering may affect the mental integrity of posterity, through the agency of hereditary influence, I consider not only possible but highly probable. We know that the morbid conditions of the central nervous system engendered by alcoholic excesses are, in a measure, capable of transmission; and this holds true as well of various neurotic tendencies. The conclusion that the *abuse* of tobacco may be a fruitful source of eventual brain exhaustion and permanent insanity seems therefore, to me, justifiable on the score of the morbid effects of the drug on brain-function, as well as on account of strong

arguments derived from analogy. To admit, however, that the *abuse* of tobacco is conducive to mental decline is one thing, but to condemn its legitimate physiological employment is another. Considering what obstacles human beings at large have to encounter—the pain, the disappointment, the sorrow and extreme mental worry—I can not help believing that the *physiological* employment of tobacco is not only admissible, but, under certain circumstances, even desirable. But what, it may well be asked, is the physiological quantity? That, unfortunately, is a question which each individual must decide for himself. This much, however, may be said concerning so delicate a point: Smoke only after meals; smoke light tobacco; do not smoke during the morning hours, and, in fact, when actively engaged; smoke only enough to obtain a very mild soothing effect; smoke the very best tobacco. If the slightest unpleasant feeling is experienced by one already habituated to the use of the drug, then the tobacco is too strong or of inferior quality, or the indulgence has been too prolonged. This is by no means all which might be said on the subject; but here, unfortunately, the oracles are few. In the preceding pages it has been my endeavor to discuss in a general way the influence exercised by tobacco upon the functions of the brain, but I have not by any means sought to present an extended dissertation on tobacco; that has already been attempted by others sufficiently often. What most nearly concerns us here is the formation of as rational an opinion as possible concerning the good or bad effects which tobacco actually exercises upon the central nervous sys-

tem. Having said as much on this interesting and important subject as space will permit, let us consider somewhat those effects which alcohol exerts upon the central nervous system. A very important primary effect of alcohol, even when administered in moderate quantities, is an increase in the heart's action. This symptom is particularly worthy of note in this connection because of the concomitant acceleration in the cerebral circulation, as indicated by the increased pulsation of the carotids. The second important effect of alcohol is to paralyze to a greater or less degree the vaso-motor center. It is clear that capillary expansion and an accelerated heart-beat favor the passage of a greater amount of blood through the cerebral capillaries in a given length of time than under normal circumstances. In other words, we shall have, in a given length of time, a greater supply of oxygen to the brain tissues—a state of things equivalent to increased intra-cellular metamorphosis; or, in a word, we have an increase in the amount and intensity of brain-function. This, at least, is the condition prevalent during the period of exhilaration. If the consumption of the stimulant be still persisted in, there is produced a still greater increase in the rapidity of the heart's action.

The increased pressure within the cerebral circulation conveys a still greater quantity of alcohol to the ganglia in a given length of time; and it now appears that the alcohol itself exercises an effect upon the cells which eventually results in the production of a state of mental and motor inco-ordination, followed at length by a condition of complete mental inertia. This, it seems to me,

is the most rational conception of the physiological factors of drunkenness. After the pernicious indulgence has been persisted in for a considerable period, the vaso-motor anomalies incline to permanency. The livid facial expression, which formerly persisted only as long as alcohol was actually present in the system, is now an ever-present symptom. Examination reveals the capillaries of the face in a state of chronic expansion. If, at the period of which we are speaking, the person die and the skull be opened, the membranes containing the vessels which supply the cortical area of the brain are found to be thickened and the blood-vessels often abnormally distended. What were the mental phenomena which co-existed with these morbid vascular changes? If careful observations were made *ante mortem*, it appears that the memory was deranged, that the mind was lethargic, and the perceptions inaccurate and slow. Sometimes the loss of mental power is so great as to almost simulate dementia. The sense of moral responsibility is blunted; cerebration, such as it is, becomes irregular, and from this wretched condition there is but a step to severe mental impairment. That the morbid changes which we have referred to must of necessity result in the production of an abnormal susceptibility of the brain to extraneous impressions is evident enough when the importance of any material change in the cerebral circulation is duly considered.* Consequently, on the strength of the pathological findings alone, we should be justified in predicting that alcohol,

* *Vide* my monograph on "Carotid Compression." Anson D. F. Randolph & Co., New York.

when taken to excess and for long periods, must predispose to brain exhaustion and insanity. We are not obliged to resort to theory, however, to prove our position, for statistics derived from the asylums and private institutions for the insane throughout the world prove that the abuse of alcohol is one of the most fruitful sources of premature mental decay and eventual mental alienation. But the immediate effects of alcohol are not the only evil to be dreaded. On the contrary, it is but too well established that the baneful effects of alcoholic excesses are liable to be transmitted to future generations. Probably, all things duly considered, alcoholic abuses constitute one of the most prolific causes of insanity, and give rise to more crime and misery than any other single factor of modern life. When rationally employed, however, for purposes of therapy, it constitutes one of the most powerful and effective remedies which we possess.

In a most interesting work on "Study and Stimulants," by A. Arthur Reade,* is contained the testimony of a host of literary and scientific gentlemen respecting their individual experience with tobacco and alcohol. This information was communicated to Mr. Reade by letter; and, from the evidence thus obtained, he feels justified in drawing the following conclusions, which I insert, regardless as to whether they coincide with my own opinions or not:

1. "Alcohol and tobacco are of no value to a *healthy* student."

* *Op. cit.*, p. 200.

2. "That the most vigorous thinkers and hardest workers abstain from both stimulants."

3. "That those who have tried both moderation and total abstinence, find the latter the more healthful practice."

4. "That almost every brain-worker would be the better for abstinence."

5. "That the most abstruse calculations may be made, and the most laborious mental work performed, without artificial stimulants."

6. "That all work done under the influence of *alcohol* is unhealthy work."

7. "That the only pure brain stimulants are external ones—fresh air, cold water; walking, riding, and other outdoor exercises."

XIII.

MENTAL HYGIENICS.

In the preceding pages the predisposing and exciting causes of brain exhaustion have been considered at some length. The influence which tobacco and alcohol exercise upon the central nervous system has also been discussed with a view to determining what measure of responsibility is to be ascribed to these two agents, respectively, in the production of premature mental impairment. It now remains to consider briefly those laws the observance of which will enable the brain-worker to employ his mental energy to the best advantage to himself and society, and with the least liability of temporary or permanent damage to the thought mechanism.

One of the most important rules to be followed by those brain-workers who hope to employ their days to the best advantage is not to allow the mind to fall into too desultory methods of action. By this I do not desire to convey the impression that universality of acquirement is something to be avoided. What I wish to deprecate is the habit of allowing the main objects of life to become the mere toys of transitional moods and circumstances. The persons who are the victims of

these desultory methods of thought constitute the very large class who are constantly "waiting for something to turn up." The psychological peculiarities of these individuals are very interesting, as well to the political economist as to the physician. The mental organization of such persons is usually anything but inferior—an apparent inconsistency, when their numberless failures in the practical vocations of life are considered. Sometimes they are professional or business men, who for some reason or other have lacked the essential talent of making their acquired or natural qualifications thoroughly understood by the community, and have therefore been forced either to sink into obscurity or adopt some other employment. Usually they prefer the latter expedient, choosing rather to assume the annoyance and responsibility incident to the acquirement of a new calling than to continue longer in a profession or business which at the best appears to them to hold out but remote and meager inducements. Hardly, however, have they become somewhat familiar with their new duties than, hearing of some "chance," some "great opportunity," they again relinquish all and adopt some new vocation. The result of all this is the expenditure of a perfectly incredible amount of unproductive labor, which, had it been properly directed and concentrated in the beginning, would have been more than sufficient to secure permanent success.

This class of persons is a comparatively recent American product, their appearance dating, so far as I have been able to trace out their pedigree, from the gold

fever of 1848. Since that time, however, every war, every mineral discovery, and, in fact, every speculative factor, has added to their number, so that, finally, the disease has spread to a surprising degree. If the early immigrants to this country had been largely composed of such material as this, we should never have had a republic embracing the better part of a continent, nor should we have known anything of that gigantic industrial and mechanical progress which is so distinctive a characteristic of the present age. Owing to the countless mishaps to which these mental nomads are constantly liable, they are particularly subject to the inroads of mental disease. But it is not alone the mental wear and tear to which such persons are liable that result in the production of a predisposition to intellectual shipwreck. On the contrary, the most potent cause of mental decline in these individuals is their total inability to rise above even the trivial accidents of life; they suffer, in fact, from a chronic susceptibility to extraneous impressions of all kinds. As the years roll on and success is still a stranger, they begin to regard themselves in the light of martyrs; and, whether their eventual fate is insanity or oblivion, they entertain to the last the delusion that they are emblems of unappreciated greatness. This class of individuals affords the best possible proof of the baneful effects produced upon the thought mechanism by desultory, prodigal, and unsystematized methods of work. Besides these intellectual harlequins, there is, however, another class of brain-workers, who are affected in a totally different manner by the obstacles

encountered upon the road to fortune. These constitute the so-called "thrifty" or "enterprising" classes. Upon this portion of society all difficulties incident to individual advancement act as but so much additional stimulus to increased exertion; every opportunity is seized with avidity, made the most of, or, should there be no visible opportunity of strengthening the material or social position, then in some mysterious manner an opportunity is created. This element constitutes the foundation-stone of town and State, and represents the specifically American aspect of our civilization.

No State can be considered progressive or prosperous which does not number among its citizens many such promoters of progress. But how much real happiness "enterprise" of the exaggerated type actually brings to the individual himself is a vastly different question. Judging by the statistics furnished by every great town, it would seem that what is really meant by the term is nothing more nor less than the spectacle of an individual working more, worrying more, and sleeping far less in a given length of time than is consistent with even the lowest physiological estimate. The reason for all this is traceable to a variety of sources. In the first rank among causative-factors belongs inordinate social ambition. Thus we find that a man who, if he conducted himself with reasonable propriety, could live at Dresden or Munich in comparative simplicity, and yet retain his friends, is in New York compelled to strain every nerve in order to pay for the requisite amount of social brick and mortar. The result of all this is an

amount of mental waste which soon outstrips the processes of repair, and brain exhaustion and other forms of mental derangement are but too frequently the end. But, it may be asked, what is the utility of protesting against the spirit of the times; what possible use is there in attempting to change the exigencies of an age? The rejoinder is simple, at least from a physiological point of view: We do not protest against the "spirit of the age," nor its exigencies, but we do protest against the manner in which those exigencies are but too frequently met.

For instance: If an individual is obliged to labor with his brain more or less during the hours of daylight, it is impossible to demand that he should afterward entertain his friends, should attend political meetings, should eat club-dinners, should make very protracted visits, or, in a word, should occupy himself in such wise that he is prevented from the enjoyment of sleep before the hour of midnight. It is not the temporary change of occupation which is objected to, for that in itself often constitutes a most agreeable form of rest; but it is rather against the loss of sleep thereby entailed that we would most decidedly protest. That the repair of the waste incident to intellection takes place very much more rapidly in some subjects than in others is not to be denied. Witness, for instance, the extraordinary independence of sleep enjoyed by Frederick the Great, Napoleon Bonaparte, and others. Nevertheless, for the majority of individuals, and particularly for those engaged in intellectual pursuits, a large amount of sleep

is a matter of the very first importance, in order that the waste incident to intellection may be effectually neutralized. When this is not the case—when the amount of sleep is insufficient—the spectacle is presented of a deterioration or gradual atrophy affecting at first the adipose and muscular tissues. Soon, however, the predominance of the process of disintegration makes itself felt in the domain of the cerebral economy. On awaking in the morning there are sensations of heaviness and vertigo, as well as occasional pains at the vertex on sitting up in bed. The morning hours, instead of being those best adapted to brain-work, are characterized by a persistent mental lethargy, so that a frequent complaint at this time is that the individual is "not half awake till noon." Digestion also suffers. Breakfast is not relished, and, in lieu of food, coffee or other narcotics are consumed. Stimulants are also brought into requisition, in the hope of urging the fatigued brain on to new endeavors; but instead of energy we have only a state of extreme irritability, disagreeable alike to the subject and his friends. But the most serious complication of this condition is sleeplessness, which usually comes on gradually, but, when once established, can only be gotten rid of by the most careful treatment. As soon as the insomnia has become thoroughly established there is a rapid decline in mental power, and a series of phenomena make their appearance, which, having been elsewhere described,* I abstain from enumerating on the present occasion. Enough that from the inception of the in-

* "Brain Rest." G. P. Putnam's Sons, New York, 1883.

somnia there is a well-marked deterioration in mental power, which may eventually, and in a large number of instances does, actually end in complete brain exhaustion or insanity. In the preface to his very recent work on insanity,* Dr. Hammond says in relation to sleep: "I think that a knowledge of the physiology and pathology of this function should form the groundwork of the study of insanity. . . . It is in aberrations of sleep that we often find the first indications of aberrations of mind." In speaking of the influence of sleeplessness as a promoter of functional nervous disorders, I have said in a monograph, to which I have just referred:† In spite of the salutary effects obtained by an almost incredible subdivision of labor; in the face of a considerable reduction in the amount of toil required from the laborer *per diem;* and in spite of gigantic strides in the realms of hygienic and prophylactic medicine—there seems to be something inherent in the very mechanism of progress which, in variable degrees, conditions a greater or less amount of subversion of physiological law. Nowhere are the opposing influences of these occult foes to organic life so plainly visible as in the domain of the nervous system. Irritability, habitual melancholy, brain exhaustion, hypochondria, and severe mental disease are a few of the symptoms which follow in the wake of an increasingly complicated existence; and what is of particular importance here is the fact that these and similar disorders

* "A Treatise on Insanity in its Medical Relations." New York: D. Appleton & Co., 1883.

† *Op. cit.*, p. 40.

of the nervous system can almost always be traced to some primary disorder of the function of sleep. The most important physiological requisite for brain-workers, then, is an amount of sleep sufficient to complete the repair of the waste which has taken place in all tissues, and particularly in those of the brain, during functional activity.

Hardly less important to the mental well-being of the individual than a physiological amount of sleep is the proper and habitual limitation of the emotions. This would seem at first sight exceedingly difficult, if not a psychological contradiction; but, in assuming its possibility, two important principles are taken into account—volition, and the possibility thence derived of substituting purely intellectual occupations or habits for those involving a greater or less amount of emotional expenditure. Habits of consistent, intellectual supervision of the emotions, when once formed, are one of the most precious acquisitions of life. I have referred to this question when discussing, in a former publication, the hygienic rules to be observed in connection with sleep.*

Good habits are levers to volition; and he who understands this principle of human action will be strong and invincible in the various undertakings of life. Among the rules which I have laid down in former publications for maintaining the function of sleep in a healthy condition occurs the following: All worry and vexatious circumstances should, as far as possible, be *habitually* excluded from the mind for a considerable time

* *Op. cit.*, p. 29.

before the regular hour for retiring. Now, one of my critics asks, very pertinently, it seems to me, how this is to be accomplished. My reply in simple terms is this: I rely, in the first instance, upon a systematic exercise of volition; secondly, upon the aid afforded by habit, which can not be overestimated; and, lastly, I depend upon the assistance afforded by the custom of throwing the mind into some intellectual employment—experience having abundantly proven that there is nothing capable of exerting an inhibitory influence upon the emotions comparable with pure ratiocination. To those who, by some species of occult reasoning, have been led to found their hopes upon some pseudo-scientific expedient, such rules as the above seem disappointing from their very simplicity, and, like those fanatical advocates of "temperance" who would have the limitations of human indulgence determined by act of Legislature, these quixotic persons would shirk the disagreeable responsibilities of an exercise of will in the face of opposing emotions by substituting for volition some paltry and inadequate expedient.

The amount of civil liberty in a community is in proportion to the average volitional capacity of society; and representative governments can, and actually do, no more than give expression to the general will-power of society. Reforms begun in legislatures are of short duration, and permanency is alone assured to those institutions which have taken an abiding root in the very traditions of society. And so it is with the economics of the individual.

If, for the purpose of correcting a deviation in physio-

logical rhythm, we resort, for example, to some species of palliative treatment, instead of seeking to eliminate the exciting cause, our victory over morbid opposition will be alike incomplete and brief. But if, for instance, where the exciting factor has been the outgrowth of some psychological failure, assuming the form of an injurious habit, the result of want of perception, or taking on the shape of excessive worry, we bring the whole force of the mind to bear upon the problem of eradicating the baneful factors, we shall achieve a permanent result, and one which can not but eventuate in a very considerable strengthening of the will. Government is the product of the aggregation of the vital energies of an entire people. Volition is the outgrowth of all the faculties of the mind. To improve government, we must begin with the individual members of the State; to strengthen volition, we must commence with the single faculties of the mind. The aim of the State should be to make government the director of the highest convictions of society. The ambition of the individual should be to make volition the executor of the loftiest aspirations of the understanding. There is no omen of the decay of a State so sure as the need of resorting to foreign intervention in the affairs of government; there is also no sign which points with more certainty to physical and mental decay than the necessity of perpetual external interference with the affairs of body and mind. A very considerable analogy exists between the pathology of States and that of individuals; indeed, the former may be said to be the outgrowth of the latter. No one is fit to become a political

economist in the highest sense who has not very well defined knowledge concerning the physiological exigencies of the individual. Nor should such knowledge be confined to an apprehension of the requisites of the purely physicial functions alone; but should, on the contrary, include, as well, a proper apprehension of the physiological principles concerned in the manifestations of mind. The conduct of society is determined by the sum of the reactions of the individuals which compose it; and, if we are to treat the maladies of States, we must begin with the morbid, mental, and physical manifestations of the individual. I have indulged in this apparent digression from the immediate topic under discussion in order to exhibit the many-sided and far-reaching aspect of the subject. The time has long since gone by when medicine was simply the art of neutralizing the morbid accidents to which the individual is exposed. Since the triumphs of physiology, particularly in the domain of the cerebral economy, there is a growing tendency on the part of writers upon politico-economical subjects to appreciate the fact that there are more profound principles to be considered in defining the relations of human beings to each other than the law of demand and supply (as currently understood). A true and humane philosophy of society is alone to be discovered in the physiological exigencies, both mental and physical, of the individuals who compose it.

Besides an habitual supervision of the emotions through the agency of the purely intellectual processes, care should also be exercised in the employment of the

ratiocinative faculties as well. The above applies with particular force to that large class of individuals who become easily fatigued from the effects of mental work of all kinds. Such persons usually exhibit a marked neurotic tendency, and are currently known as "nervous." They are a thin-blooded and small-waisted fraternity, with but little reserve energy. Upon a superficial glance, it would appear as though but a meager output of cerebral force could be anticipated from those possessed of such scanty physiological facilities; and yet, when properly directed, it is astonishing how much energy may actually be obtained from such unpromising material. Such individuals are, in fact, remarkable on account of the rapidity with which they are enabled to evolve nervous force; their only fault is inability for long, protracted effort—the intellectual flame is bright enough while it lasts, but it soon flickers and grows dim.

Now, to apply the same rules to such persons as to those of more robust mental and physical endowments would be manifestly unjust; and yet they should not be subjected to the ruthless effects of an illiberal "law of the survival of the fittest," for their energies may redound to the welfare of society under the beneficent influence of an appropriate hygiene. The rules applicable to those of scanty mental reserve power may be briefly summarized as follows: Avoidance of—1. Excessive indulgence of the emotions. 2. Of frantic, desultory efforts to accomplish in one hour an amount of mental work appropriate to double that amount of time. 3. Of every species of excess which experience has proven

leads to general constitutional drain. 4. Of attempting to do two things at one and the same time. 5. Of petty social or other engagements which interfere with the function of sleep. 6. Of constipation, as experience has abundantly proven that this condition is productive of abnormal mental depression. 7. Of rich, indigestible food.

If the above rules are conscientiously adhered to, there need be but slight fear of mental bankruptcy.



CONSIDERATIONS ON THE PRINCIPLES OF TREATMENT.

XIV.

OF THE RELATION OF THE BLOOD TO MUSCLE AND BRAIN.

WITHOUT entering into the minutiæ of the subject, I propose to discuss in this place some of the more important points with regard to the relationship subsisting between the blood-stream on the one hand, and muscle and brain on the other.* It is a law of physiology that every tissue receives just that amount of the vital fluid which its importance as a histological unit in the organism justifies. Not only, however, is the quantity of blood conveyed to an organ directly proportioned to its physiological importance, but, moreover, the amount itself is varied according to whether the organ is active or in a state of functional quiescence. This is particularly true of the glands and muscles. As to the brain, there are many points of resemblance between its mode of action and that of the glands, as far as the circulation is concerned. The quantitative demand which an organ makes upon the nutritive resources of the blood-

* The purely experimental side of the question has been exhaustively treated in former communications, so that an extensive recapitulation of the inductive data is unnecessary. What I have sought after more particularly in this place is the presentation of some inferential data, which I trust may not prove entirely without interest.

stream is, moreover, speaking in general terms, directly in proportion to the degree of vascularity of the tissue of that particular organ.

Following the above proposition to its proper sequences, we should expect an undue demand, on the part of one particular organ or group of organs upon the nutritive resources of the blood, to result in a proportionate impoverishment of the rest of the organism. And this is indeed the case. If the muscular system be persistently and unduly developed, there is an inevitable loss to the remaining tissues of the organism unless the blood-making facilities of the individual be unusually large. First in the order of impoverishment come the fatty tissues; there is a gradual decline in quality, and an eventual complete absorption of the adipose strata. So far does this absorption sometimes extend in professional athletes that the face, denuded of its fatty covering, assumes a positively emaciated appearance, the masseter muscles and zygomatic arches standing out in direct violation of all plastic rules. Sometimes the abstraction of the nutritive resources of the general organism is so great that vital organs become affected by the blood-famine; and it not infrequently happens that the first warning which the individual has of his condition is, for example, a violent hæmorrhage, the precursor of impending dissolution. Pulmonary complaints are indeed among the most frequent causes of death among gymnasts.

What is true of the lungs applies with equal force to the brain. Nothing is more certain than that those

whose muscular systems have been inordinately developed are frequently incapable of protracted mental work; not because muscle-workers suffer from any cardinal brain-defect, but for the reason that the blood-making facilities of these individuals are incapable of meeting the combined demands of brain and muscle.

We have heard much of late years respecting the benefits to be anticipated from what is termed "physical culture." But, unfortunately, the term itself is misleading. A good physical constitution is indeed the foundation-stone of a healthy understanding; and if by "physical culture" the functional perfection of the various component parts of the organism were understood, then the most exacting physiologist could find no fault. It is to be regretted, however, that some of those who would remodel a defective physical constitution seek only in an inordinate development of the muscular system for a consummation of their theories. The position of these enthusiasts is the more regrettable for the reason that their zeal having given rise to no little harm, society at large has begun to lose faith in the teachings of scientific hygiene. The excess to which the cultivation of the muscular system has been carried in the various colleges of the country has gone far toward undermining the faith of some persons in the efficacy of what is boldly put forward by its advocates as the only true system of bodily improvement. The spectacle of a regiment of brawny athletes with brains as efficient as their muscles would indeed be a wonderful spectacle. But the truth of the matter, as already intimated, is that there are

few who have the digestive facilities adequate to the support of both excessive brain and muscular demands. Either the brain must give place to the muscle, or the latter is obliged to concede unduly to the former. In any event, we have to do with a state of things totally at variance with the rules dictated by deductions from sound physiology. The opinion that the muscular system constitutes, as it were, the reservoir of vital forces for the rest of the organism is not, however, confined exclusively to non-professional circles, for medical men, whom physiology should have taught differently, seem more or less imbued with this idea. Thus, in Dr. Weir Mitchell's well-known little work * occurs the following in the chapter on "Rest": "When we put the muscles at absolute rest we create certain difficulties, because the normal acts of repeated movement insure a certain rate of nutrition which brings blood to the active parts, and without which the currents flow more largely around than through the muscles. . . . The lessened blood-supply is a result of diminished functional movement, and we need to create a constant demand in the inactive parts. But, besides this, every active muscle is practically *a throbbing heart*, squeezing its vessels empty while in motion, and relaxing, so as to allow them to fill up anew. . . . Thus, both for itself and in its relations to the rest of the body, its activity is functionally of service." This is certainly very ingenious language. Unfortunately, however, for the integrity of the argument, the

* "Fat and Blood," by T. Weir Mitchell, M. D., p. 49. Philadelphia: J. B. Lippincott & Co., 1882.

conception of each muscle as a "throbbing heart" is physiologically incorrect. The difference between the heart and muscles with regard to their respective relations to the circulation is this: The heart is an organ containing cavities of comparatively vast extent, filled with the vital fluid. Of the blood contained within these cavities, the heart itself requires but a comparatively *infinitesimal amount* for the purpose of its own nutrition. How different is the relation of the muscle toward the vital fluid which it contains! Entering the muscle by way of the arteries, the blood proceeds to distribute itself throughout the organ by means of the capillaries, and returns again to the heart through the veins. During this journey through the muscle, important changes have taken place in the constitution of the vital fluid.

On entering the muscle the blood was red, and thoroughly oxygenated; but on leaving the organ it is dark, loaded with carbonic acid and the *débris* incident to the tissue metamorphosis within the muscle. How great that metamorphosis is, physiology has abundantly shown. Of the blood contained within the left ventricle of the heart but an insignificant amount is required, as we have seen, for the nutritive purposes of the heart itself, almost the whole quantity being immediately available for the uses of the general economy. But *all* the arterial blood contained within the muscle is distributed through the capillary net of the organ itself, deprived of its nutritive qualities, and sent back through the veins in a condition of impoverishment, which renders a con-

siderable portion of it unfit for service to the rest of the organism. It is therefore physiologically inconceivable that the muscles should fulfill functions analogous to the heart, for the very good reason that the heart is in great measure a distributer of vital energy, while the muscle, on the contrary, is an absorber of the vital energies of the blood contained within its vessels. In an admirable contribution to the physiology of muscular action,* Dr. Flint says: "Finally, experiments upon the human subject show that the direct source of muscular power is to be looked for in the muscular system itself. . . . The exercise of muscular power immediately involves the destruction of a certain amount of muscular substance, of which the nitrogen excreted is a measure. . . . Indirectly, nitrogenized food is a source of power, as, by its assimilation by the muscular tissue, it repairs the waste and develops the capacity for work; but food is not directly converted into force in the living body, nor is it a source of muscular power, except that it maintains the muscular system in a proper condition for work. . . . In ordinary daily muscular work, which may be continued indefinitely, except as it is restricted by the conditions of nutrition and the limits of age, the loss of muscular substance produced by work is balanced by the assimilation of alimentary matters. . . . A condition of the existence of the muscular tissue, however, is that it can not be absolutely stationary, and that *dissimilation must go on to a certain extent, even if no work be done.*" In this

* "The Sources of Muscular Power," by Austin Flint, Jr., M. D. New York: D. Appleton & Co., 1878, p. 97.

last clause is embodied the idea from which I desire to draw conclusions of practical weight. It has for some time been the fashion in France as well as in this country to lay stress upon certain specific manifestations of the muscular system as an item of importance in the treatment of nervous disorders. As at first employed, the system of "massage" proved itself valuable in the treatment of certain defective systemic disorders, as well as in cases involving directly or indirectly more or less impairment of the motor apparatus. From a legitimate use, however, the practice of manipulating the muscles has degenerated into a therapeutic "hobby," so that at the present time the offices of the "*masseur*" or "*masseuse*" have been brought into requisition in every species of disorder from headache to prolapsus uteri. In cases of defective brain nutrition it has also been employed to a large extent in some quarters, as if over-nutrition of a muscular fiber could in any way help an already impoverished brain-cell; or as if diverting the insufficient blood-supply in a feeble subject from an inadequately nourished brain to the muscles could in any way enhance the available vital units of the central nervous system! I do not, however, wish to intimate that in *some* cases, owing to circulatory or other insufficiencies, the amount of blood in the brain may not be abnormal and require special therapeutic attention. What I wish to protest against is the assumption that the particular development of the muscles can cure a defectively nourished brain any more than an illegitimate diversion of the vital fluid to the nervous centers can conduce to the

benefit of the muscular system. The assumption that a diversion of energy from an organ will conduce to the formation of tissue in that same organ is at direct variance with all that we know of the correlation of forces. Moreover, the results of practical experience are directly at variance with such an unphilosophical hypothesis. Some of the worst cases of brain exhaustion which have ever come under my observation were among those in whom the muscular system was artificially developed to a degree totally out of harmony with the capacity of the assimilating apparatus. I have frequently remarked that such individuals are remarkably small at the waist, while the chest capacity may be good, or even above the average. This combination of large "burning" power with inadequate facilities for the preparation of "fuel" constitutes an unfortunate equipment on the part of the individual for maintaining his physiological integrity in the face of the attrition which the external world is constantly exercising against living organisms.

XV.

INDUCTIVE AND DEDUCTIVE CONSIDERATIONS ON THE RELATION OF CERTAIN KINDS OF FOOD TO THE EVOLUTION OF MENTAL PHENOMENA.

THERE is one great principle of animal life which, if properly understood, will prove of invaluable assistance in dealing with defective brain nutrition—I refer to the specific chemical relationship existing between the components of certain tissues of the organism on the one hand, and particular kinds of food on the other.

We have already seen that direct investigation has proven that mental work involves the consumption of both the nitrates and phosphates.* Moreover, these facts are in harmony with analyses of the constituents of the brain itself, so far as such have been attempted. One investigator has shown that the amount of phosphorus contained in the brain is greatest among those of active intellect, and that it increases in amount with the growth of the individual, attaining the maximum quantity at the period of adult life. In the aged the quantity is considerably reduced. Again it has been found by some that the amount of phosphorus contained

* *Vide* "Preliminary Considerations."

in the brains of idiots is much below the normal. These are certainly significant facts, and well worthy the careful consideration of those who still persist in questioning the ample statistics bearing upon the important *rôle* played by the phosphates in cerebral physiology. It must, however, be confessed that the more intimate chemical changes in the active brain are still far beyond the reach of modern methods of investigation. There exists, indeed, no satisfactory analysis of the complicated chemical bodies which compose the brain; and, where elaborate tables of the cerebral constituents have been prepared, very little faith can be placed in the formulæ, as they represent, no doubt, in many instances, nothing more than mixtures.

When, however, the great complication of the subject is considered, the wonder is that we know anything at all of brain metamorphosis.

But, in addition to the part played by the phosphates, experience teaches that to nitrogen must be assigned a prominent place in the regimen of the brain-worker. Where mental courage, tenacity of purpose, and concentrated energy are required, the introduction of large quantities of fibrin and albumen into the system produces the most marvelous results. Thus, flesh-eating nations have ever been more aggressive than those peoples whose diet is largely or exclusively vegetable. The effeminate rice-eaters of India and China have again and again yielded to the superior moral courage of an infinitely smaller number of meat-eating Englishmen. Nor are we obliged to seek alone among modern nations for in-

stances of the moral courage inspired by a meat diet. Thus, the ancient Spartans placed particular stress upon a flesh diet as a means of stimulating intellectual courage. One of the most striking examples of the restless and dauntless spirit engendered by the consumption of animal food is afforded by the aborigines of North America, who, previous to the introduction of agricultural pursuits among them, lived almost exclusively upon the flesh of animals killed in the chase. These Indians, during the early days of the colonies, not only made war with singular skill and bravery, but were also noted for their passionate eloquence and heroic fortitude in adversity. How totally different from these Indians are the present wretched natives of Peru and Mexico! But by far the most wonderful instance of the intellectual vigor of flesh-eating men is the unbroken triumph of the Anglo-Saxon race. Reared on an island of comparatively slight extent, these carnivorous men have gone forth and extended their empire throughout the world.

A most striking exemplification of the peculiar mental vigor of flesh-eaters is afforded by the life of Warren Hastings, the true founder of the English Empire in Hindostan. Born poor, without influence, and with nothing to commend him to the favor of others but his own dauntless resolution, this man was placed, while yet but a mere youth, in a subordinate position, on a miserable salary, in the midst of the countless millions of India, whose sole ambition was the extermination of himself and the handful of English who composed

the insignificant settlements of the East India Company. Could more unpromising conditions be conceived of for the manufacture a hero? And yet, from out the depths of these unpromising surroundings, Hastings rose through the sheer momentum of a powerful understanding. The physical power — the mere superiority of brute-force and numbers—was all on the side of his opponents. Nor was low cunning—that refuge of weak brains—absent among the opposing forces. Treachery, lies, avarice, were the inevitable accompaniments of the greatest and smallest transactions. But all the forces of darkness were alike unavailing against the mental mechanism of this one man, whose lion-like qualities sufficed, with the assistance of a handful of flesh-feeding followers, to make himself master of millions of rice-eaters!

The only occasion when this race of nitrogen consumers has suffered a check in the contest for empire has been when brought face to face in conflict with its own flesh and blood. The defection of the American colonies, as well as the war of 1812, are examples of the great flesh-consuming race of modern times pitted against itself. The world knows the result. In spite, however, of the fact that the Anglo-Saxons have become divided as far as government is concerned, the same mental traits which made Hastings master of India are still present to a great extent among the present inhabitants of New England and the Northwest. There is something in the physiognomy of an American which betokens not only acuteness, but a capacity for

dogged resistance—a mental fearlessness which knows no obstacles but dissolution. It is this mental courage which makes the American eminently a man of affairs, and, in spite of the phenomenal afflux of foreigners to these shores, lends a specific stamp to the civilization of the republic. What would have been the fate of the heterogeneous elements of this country without the leavening influence of the descendants of the flesh-consumers of England it is very difficult to say. Certain it is, however, that the various races of men, ingrafted into the original branches of the republic, have assumed the qualities of the mother-stem with a rapidity bordering on the marvelous. The first generation of emigrants may seek to perpetuate the languages and customs of their native land, but the second generation has assumed the specific habits and modes of thought of the adopted country. There is something contagious in what is termed the "American" political system—a condition of things originally brought about by the extreme individualism of the Anglo-Saxon mind. This "individualism" is opposed to the tyranny of the few and the many alike. Hence communism and absolutism are equally foreign to the Anglo-Saxon character. To be dictated to by the mob is as preposterous from his standpoint as to bend the knee before the throne of a feudal lord. This love of independence of the Anglo-Saxon race has been traced to all kinds of sources by political economists; but to the physiologist the question is comparatively simple. Take away the roast beef and mutton from England and her colonies to-day, and but a

generation or two hence we should see the flame of liberty flickering, or perhaps even totally extinguished.

I once had occasion to witness the demoralizing effect upon the intellectual faculties produced by the almost total withdrawal of flesh from the dietary of a number of English school-boys. These lads, who had always been active, healthy, and intelligent, were sent to a continental boarding-school in the province of Würtemberg. On their arrival, and for some time afterward, the grade of food provided was comparatively good, consisting of vegetables and meat. During this time the lads remained active, playing at foot-ball and performing their intellectual tasks well, and evincing every sign of mental vigor. By degrees, however, the head of the institution, an unscrupulous individual, decreased the amount of meat provided to such an extent that, as one of the inmates said afterward, "it seemed as if dinner, breakfast, and supper consisted of nothing but turnips, potatoes, and cabbage." Under this *régime* the health of the English lads showed a progressive decline—the deterioration in energy being especially evident in the reduced capacity for mental labor. They became listless, stupid, and so far dejected that the ordinary every-day exercises of the school-room were looked forward to with positive dread. A more striking example of the deleterious effects exercised upon the capacity for brain-work by a withdrawal of flesh from the dietary has rarely come under by observation.

Nitrogen is indeed the great chemical prerequisite for the maintenance of energy of the most diverse

character. Its co-operation is as necessary to the contraction of the voluntary muscle or the evolution of mental phenomena as to the explosion of nitro-glycerin or gunpowder.

In the foregoing remarks concerning the importance of nitrogen to the cerebral economy of brain-workers I have relied solely on the results of experience, and for this reason: that, as Hermann * confesses, it is impossible, in the present state of physiological science, to found a system of dietetics based solely on our yet very imperfect knowledge of tissue metamorphosis. Nevertheless, in the face of the theoretic difficulties of the case, I have seen no reason why we should not appeal to such empirical data as society at large affords. This indeed is nothing more than an appropriation of such experimental results as are afforded by life itself; and, until physiology has done more for us, we must content ourselves to a great degree with purely empirical data.†

Before concluding this general discussion, I can not abstain from offering a few words of suggestion with regard to the proper employment of wheat as an article of food. It is scarcely necessary to insist upon the great importance of this cereal as an article of food for brain-workers; that indeed would be to reaffirm what is already abundantly demonstrated. What I wish to draw atten-

* "Grundriss der Physiologie des Menschens," von Dr. L. Hermann, Dritte Auflage, Berlin, 1870, p. 182.

† It is interesting to note, however, that the conclusions arrived at, from purely sociological considerations, relative to the value of the various combinations of nitrogen and phosphorus as food for brain-workers are confirmed, so far as they go, by the results of urinal analysis. (*Vide* the experiments of Hammond and others in this direction.)

tion to, however, is that which can not fail to be regarded as an improper preparation of this grain; I refer to the process of bolting, by which the kernel is deprived of a large percentage of its nutrient constituents.

In order to understand the truth of the foregoing, it must be remembered that a kernel of wheat is composed of (1) an external layer, principally composed of nitrates, (2) an internal portion, composed of carbonates or heat and fat producers, and (3) a chip or germ containing the phosphates, which are so important a constituent of brain and nerve tissue. I do not wish to imply by this that an actual mathematical subdivision of the elements is represented by the stratification above indicated. Thus, the phosphate of lime, which is so important a constituent of the bones, is found in conjunction with the nitrates in the external coat, whereas the soluble phosphates, so necessary to the brain, are found in the germ. While, however, an absolutely correct subdivision of the elements according to the strata of the kernel is impossible, it is sufficiently clear that these natural boundaries of the grain serve to exhibit in great measure the nutritive importance of the different zones of the latter. This is particularly true of the external layer and germ which contain those elements of most importance to brain nutrition.

Now, in the process of bolting, a large portion of the phosphates and nitrates is lost. To understand this perfectly, it must be borne in mind that gluten, which is the principal nitrogenous element in wheat, is tenacious,

whereas the starch, the carbonaceous element, is "globular" and crumbly. The practical result of this is that, in the process of grinding, the glutinous stratum is separated in flakes, and is consequently sifted out. The flour is thus almost entirely bereft of its muscle- and brain-making materials, consisting in the main of starch.

As to the outer stratum, which contains a large portion of the muscle-making portion of the grain, it is easily separated from the starch below by the process of grinding, and a large portion of it is lost with the bran.

A similar fate awaits the germ which contains the soluble phosphates—so important to brain nutrition. The molecules of this portion of the wheat being tenacious, a large part is lost with the bran.

It is perfectly evident, then, that, in employing white, superfine flour, the most important elements of the wheat are lost. Those who doubt this simply refuse to believe that which is capable of conclusive scientific demonstration.

Besides the above facts, which are sufficiently convincing to all but the dogmatically skeptical, it is a matter of history that those nations which have subsisted upon *whole* wheat are both intellectually and physically stronger than such as have lived upon white flour. Thus it is narrated that the Roman soldier's sole article of diet during long campaigns was whole wheat, which he carried with him and chewed as opportunity afforded.

The relative difference in available physical and mental strength existing between those who live entirely

on whole wheat and those who consume white flour is as great as that between meat-eaters and those who live on vegetables alone.

The best dietary for brain-workers, then, both physiologically and empirically speaking, is one the salient features of which are meat on the one hand, and unbolted cereals on the other. As a matter of course, other kinds of food should be added to suit the season, individual idiosyncrasy, and certain specific requirements of the organism as a whole.

The above applies with especial force to milk, which is an exceedingly valuable adjunct where it can be digested.

A diet of eggs, milk, cereals (whole), and beef-tea is valuable in many cases of cerebral exhaustion.

Where the milk is not easily digested, is should be given frequently in small quantities.

Of late years various extracts of whole cereals have been introduced, and some of these, when properly prepared, possess undoubted efficacy in the treatment of cerebral exhaustion. Some of these preparations have been peptonized—an excellent thing where it is desired to aid an enfeebled digestion.

Besides the preparations of reliable manufacturers, there has been introduced upon the market, through the aid of the public prints, a mass of fraudulent concoctions, which, while putting forth elaborate claims to physiological excellence, are in reality the very abomination of all quackery. Such usurpation of science has greatly tended to shake professional confidence in the efficacy

of specific nourishment in cases of deficient cerebral supply. There is contained, however, far more of truth in this branch of the subject than is usually supposed; and it is to be hoped that, with increasing physiological knowledge, a still wider application of science will be obtained in the domain of special nutrition.

These, in brief, are the more salient features connected with the subject.

XVI.

REST.

Brain exhaustion being that condition in which the cerebral cell is no longer able to hoard up the necessary amount of explosive energy—a state of things in which the mechanism of supply has become more or less defective—the problem presented for solution is how best to bring the supply of brain energy up to the normal standard. The prime requisite for the accomplishment of this end is to decrease for a time the expenditure of cerebral force to a minimum, and thereby render a gradual accumulation of brain energy possible.

By prolonged sleep it is possible for the ganglia to hoard up, in spite of the defective mechanism of supply, an amount of energy proportionate to the temporarily reduced output of brain-force. Thus by slow degrees the proper correlation between integration and disintegration may be re-established. It is useless, however, to hope for such a fortunate result at once, as, when the morbid nutritive conditions have once become established, nothing short of prolonged rest can by any possibility result in the re-establishment of the normal nutritive processes of the cell economy.

The various questions involved in the treatment of sleeplessness and allied morbid accompaniments of cerebral exhaustion have been discussed at length in a monograph of recent date.* To enter, therefore, into an extended discussion of the subject on the present occasion is not my intention; but instead I shall only present a brief sketch of the principles of the method by which I seek to fulfill what seem to me the three great requisites in the treatment of this class of cases, namely, (1) cerebral rest, (2) increased general and cerebral nutrition, (3) elimination of psychical irritation.

The patient is secluded in a darkened room from ten to fifteen hours at a time, according to the amount of sleep which it is desired shall be had during the twenty-four hours.

The amount of sleep is progressively increased by habit, moderate medication, and hydrotherapy; but no attempt is made to suddenly increase the duration of the period of unconsciousness by the reckless employment of sedatives.

When the patient awakes, which is usually the case two or even three times during the hours set apart for rest, nourishment is administered, but always in a fluid and easily digested form. Where difficulty is experienced in again falling asleep, resort is had in the beginning to limited medication. The few hours of wakefulness are devoted to some form of amusement, reading, writing, and even the mildest forms of mental concen-

* "Brain Rest," by J. Leonard Corning, M. D. New York: G. P. Putnam's Sons, 1883.

tration, are absolutely prohibited. This, in brief, is the method from which I have already seen most happy results, and from the employment of which I hope and believe much good will in future be derived.

It is hardly necessary to say that the problem of brain rest is essentially different and presents many more difficulties than spinal rest. To give repose to the motor-cells of the cord is a comparatively easy problem, and one which only exacts a permanent fixation of the motor apparatus for its solution, the consciousness or unconsciousness of the individual being only a matter of secondary importance. Rest, however, for those cells the function of which is the evolution of mind can only be obtained by a prolonged period of absolute unconsciousness; and this, as a matter of course, is not to be obtained merely for the asking, but will tax the resources, tact, and skill of the physician to the utmost.

Familiarity in dealing with this class of functional disorders, coupled with perseverance and skillful utilization of the principle of habit, will, however, usually overcome all obstacles.

Physiological Brain Rest and the Prevention of Insanity.

The most potent means of preventing the onset of mental trouble consists in preserving the function of sleep in a perfectly normal condition. That almost all forms of insanity begin with derangement of sleep has been referred to by most writers on mental disorders.

But that the great feature in the prophylaxis of insanity consists in preserving the function of sleep in a condition of physiological integrity has not been so clearly apprehended. I have sought to exhibit this aspect of the question in various publications which have appeared from time to time during the last few years.

In a systematic work on insanity, recently published, Dr. Hammond * has assigned due importance to the relation of sleep to mental disorders, devoting a large section to the consideration of various physiological questions involved. Of this work of Dr. Hammond it may truly be said that it is a permanent contribution to psychological medicine.

Derangement in the function of sleep is an infallible sign that the proper relation between the waste and repair of brain-tissue no longer exists; and that, unless the undue expenditure of brain-force be made to cease, cerebral bankruptcy is impending.

By sleep we promote a storing of brain-force, and are thus able to provide against all ordinary demands upon the resources of the thinking mechanism.

Worry, disappointment, and excessive mental work exercise their prejudicial effects upon the brain chiefly through the quality which they possess of interfering with sleep.

Could we but be sure of enjoying ten hours of perfect physiological sleep every twenty-four hours, there would be indeed few intellectual storms of sufficient po-

* "A Treatise on Insanity," by William A. Hammond, M. D. New York: D. Appleton & Co., 1883.

tency to cause shipwreck of the mind. But just here lies the difficulty: it is impossible to impose burdens upon the intellectual and mental faculties beyond a certain point without seriously interfering with that rhythmical unconsciousness which is the indispensable requisite to the proper repair of those higher centers concerned in the processes of intellection.

Since, however, the burdens of worry are at all times liable to assume inordinate proportions, it is absolutely incumbent upon those who would preserve their mental faculties in a condition of health to see to it that the mind is periodically relieved from the ever accumulating load of responsibility.

Relaxation before sleeping should be the great watchword of the brain-worker and the man of worry.

The Teutonic race understands intuitively the importance of relaxation; but the Anglo-Saxon requires to be taught the physiological significance of amusement.

Moreover, the German so arranges his hours of amusement that he can enjoy the same and yet retire to rest at a seasonable hour. A very large number of German theatres, operas, and other places of amusement begin at seven o'clock in the evening, and the details of the programme are usually fulfilled by ten or half-past ten o'clock.

In England and America, on the contrary, the places of amusement open and close at so unseasonable an hour that over half the night is spent ere the audience can retire to rest.

From this faulty arrangement it transpires that the